ELECTRICAL REVIEW

THE PIONEER ELECTRICAL WEEKLY OF AMERICA

VOL. LIII. No. 10 NEW YORK, SATURDAY, SEPTEMBER 5, 1908. ISSUED WEEKLY

CHARLES W. PRICE . . . . . PRESIDENT AND EDITOR
STEPHEN H. GODDARD . . . . . VICE-PRESIDENT
WM. HAND BROWNE, JR. . . . . TECHNICAL EDITOR
AINSLIE A. GRAY . . . . . MANAGING EDITOR

NEW YORK
PUBLISHING OFFICE . . . . . 13-21 PARK ROW

CHICAGO
WESTERN OFFICE . . . . . FISHER BUILDING

BOSTON
NEW ENGLAND OFFICE . . . . . 95 MILK STREET

LONDON
EUROPEAN OFFICE, HENRY W. HALL, Manager, 42 OLD BROAD STREET, E. C.

TELEPHONE AND CABLE
TELEPHONE "21 Cortland." Private exchange to all Departments.
REGISTERED CABLE ADDRESS: "Electview," New York.

SUBSCRIPTIONS

One Year, United States	$3.00
One Year, Canada	4.00
One Year, Foreign Countries	6.00
Single Copy, 10 cents. Back numbers, beyond one month, each	.25

ADVERTISING

CHANGES for advertisements should be in this office by *Friday noon* for the following week's issue.

NEW ADVERTISEMENTS should be in the office not later than *Monday noon* to assure publication in that week's issue.

Published weekly by the ELECTRICAL REVIEW PUBLISHING COMPANY, 13 Park Row, New York. Charles W. Price, president and treasurer; Stephen H. Goddard, vice-president; H. S. Tuthill, secretary.

Entered at the Post Office at New York as second-class matter under the Act of March 3, 1879.

CONTENTS

EDITORIAL:
- Tantalum Detector for Wireless Signaling 333
- The Boston Edison Rate Decision 334
- The Trackless Trolley for Dundee 335
- A High-Tension Transmission Decision 335

Ohio Electric Light Association 336
The Test-Meter Method of Testing Service Meters—IV, by Joseph B. Baker 342
The Care and Maintenance of Storage Batteries 345
The Telephone in Advertising a Play 345
The Korn System of Image Transmission, by C. L. Durand 346
The Direct Production of Copper Tubes, Sheets and Wire, by Sherard O. Cowper-Coles 350
Chicago Street Railway Accidents 353
Electric Smelting by the Lash Process 353
Functional Organization for the Central District and Printing Telegraph Company 353
The Pennsylvania Electric Association 353
REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE 354
A New Smokeless Fuel 355
INDUSTRIAL SECTION:
- Suction Gas Producer Power, by L. P. Tolman 356
- A New Line of Cigar Lighters for Continuous and Intermittent Service 359

The American Association of Electric Motor Manufacturers 359
Business Getting with the Tungsten Lamp at Lowell, Mass. 359
CURRENT ELECTRICAL NEWS 360
RECORD OF ELECTRICAL PATENTS 364

Copyright, 1908, by Electrical Review Publishing Co.

TANTALUM DETECTOR FOR WIRELESS SIGNALING.

During the past year or two innumerable detectors for electric waves, acting on the imperfect-contact principle, have been devised. Many of these have not been self-decohering, but occasionally a combination of metals or of a metal and some other conducting body is found which is self-restoring. Usually detectors of the latter type employ a compound of a metal, such as a carbide. The arrangements using metal on metal generally call for a mechanical arrangement for restoring the high resistance of the receptive condition. An interesting detector of this type was invented a year or so ago, and used in the Lodge-Muirhead system. This device was formed by rotating a small metallic wheel, the lower surface of which just grazed a surface of mercury covered with a thin film of oil. The rotation of the wheel served to restore the high resistance of the device, which apparently was due to a very thin film of oil adhering to the surface of the disc. This film appears to be so thin that it is punctured by the potentials produced when an electric wave is received by the antenna.

On another page of this issue a wave detector is described which employs mercury as one of the contacts and a tantalum wire as the other. The wire is exceedingly fine, being only about five-hundredths millimetre in diameter; in fact, it is nothing more than a short piece of filament taken from one of the ordinary tantalum lamps. Tantalum is not wetted by mercury, and when this fine wire is just in contact with a mercury surface the contact resistance is from 1,000 to 2,000 ohms. This resistance is not high compared with the receptive resistance of certain other receivers, but when an oscillation is received the resistance drops to about one-eighth of its original value. This ratio can even be increased if desired and the great change gives rise to very loud signals. The inventor of the detector, Mr. L. H. Walter, says that in this respect his detector is superior to most others, although it is not so sensitive as some other types for very weak oscillations. This characteristic he thinks makes the detector particularly suitable for wireless telegraphy, since the oscillation currents used in that system of communication must necessarily be relatively powerful.

Finding the combination of tantalum and mercury so excellent, Mr. Walter tried various other combinations of metals, both with mercury and with other metals; none of them, however, compared with the tantalum-mercury couple. He did find one combination of solid metals, namely, tantalum and oxidized iron, which gave fairly satisfactory results. Such an arrangement would be well adapted for use on shipboard, where the vibration of the mercury surface of the other detectors would

render them useless. However, the inventor has devised an arrangement of his mercury-tantalum detector in which the tantalum wire is in contact with a small globule of mercury entirely enclosed, and which therefore does not vibrate.

It is an interesting question as to what gives rise to this high resistance of contact. One would at first attribute it to a thin film of oxide, similar though not so strong dielectrically as the coating of oxide which forms on the aluminum plates used in electrolytic rectifiers or condensers. Such a film might be easily formed if the tantalum and mercury were momentarily separated, but when the surface of contact is entirely below the upper surface of mercury, one would hardly expect such a coating of oxide to repair itself after puncture. Another explanation might be that a thin film of air adhered to the mercury. This would prevent the latter from wetting the tantalum, but the same difficulty of explaining the self-restoring effect is met. If this thin film of air behaved as a liquid, it might be said that its surface tension repaired the break; possibly there is some such effect.

THE BOSTON EDISON RATE DECISION.

After a long investigation of the methods of charging and the rates of the Edison Electric Illuminating Company of Boston, the Massachusetts Gas and Electric Light Commission has gone squarely on record against the modified Wright-demand system used by the company, taking the ground that it is practically impossible to determine accurately the cost of supplying an individual customer, and so to proportion the charges that each customer will bear his proper share of the burden of furnishing him with service. Incidentally, a reduction in rates is recommended, but the broad general interest in the decision of the board lies in the fundamental discussion it presents of the intricate problem of central station rate making.

In summarizing its explanation of electric lighting costs the company has stated that the costs of an electric lighting company are actually the sum of what its customers' costs would be if they supplied themselves under the different conditions under which they consume current, less such deduction as is justified by the use of the plant by different customers, and such deduction as is justified by the greater economy of the company's larger plant. To make costs the basis the company divides its annual expenses into "fixed" and "running" costs. In the latter it includes only those costs which are reasonably certain to vary with the amount of current made and sold, including coal, oil and waste, water, station wages, carbons and incandescent lamps. All other expenses, including dividends, are included in "fixed" costs. The "running" costs are obtained readily by meter and operating expense records. The "fixed" costs for each kilowatt of station demand are obtained by dividing the fixed costs for the year by the number of kilowatts representing the maximum station demand. The customer's maximum demand is determined by the Wright indicator, but to allow for the fact that all the maximum demands do not come at the same time, the company modifies its rates by a so-called "diversity factor," which it defines as the ratio of the sum of its customer's demands to the actual station demand. Feeling that the cost of distributing current to small consumers is proportionally much larger than to heavy consumers, the company has introduced wholesale discounts to relieve the large customers of the excess costs occasioned by the smaller customers. A year's experience with the yearly contract lighting rate shows an average rate of 7.2 cents per kilowatt-hour; with the non-contract lighting rate, 14.2 cents; with the power rate, 5.6 cents, and with the elevator rate, where the demand system is not used, 8.5 cents.

The board points out that the justification of a system of individual rates must rest upon the practicability of ascertaining with reasonable accuracy the cost of supplying each individual customer, and of automatically apportioning this cost to him by the schedule of prices adopted. The board states that the ratio of a customer's maximum demand to the aggregate maximum demands of all customers does not, aside from the practical difficulty of ascertaining the ratio, determine the customer's proportion of the fixed costs, because actual conditions require the recognition of the so-called "diversity factors." In the year ended June 30, 1907, the maximum station load was 35,310 kilowatts as against over 48,000 kilowatts, the aggregate of the customer's demands as nearly as they could be ascertained or estimated. The diversity factors were not based upon the company's experience nor that of others supplying electricity under similar conditions. They are of the greatest importance, introduced to so correct the relation of an individual customer's maximum demand to the maximum demands of all customers that his responsibility for the station peak, and therefore of the company's investment because of it, shall be correctly proportioned. Accuracy in this process, according to the board, requires that before the "diversity factors" are used the "fixed costs" shall be divided as between lighting and power or any portion of the company's business to which they are applicable. "Such a division," says the board, "is obviously impracticable, and without it there is no demonstration that the resulting charge to the individual is proportional to his cost."

In its decision the commission states that even the "diversity factor" assumes that the cost of supplying the individual customer is based on certain average conditions, since the maximum demand may vary widely from time to time. It also criticizes the inclusion of dividends and general expenses of management in the fixed costs, and urges that it is doubtful if it is practicable, even though desirable, to ascertain the costs to the company of its individual customers and to apportion such costs in the prices charged. Finally, emphasis is laid upon the desirability of every public service charge being simple, definite and readily understood and applied.

In accepting the board's recommendation as to rate reduction, President Edgar states that the company does not wish to be understood as admitting the incorrectness of its theory of differential prices or the incompleteness of its proof that its prices are based upon cost. In view of the thorough study of

the rate problem which all the parties in interest have given it in Massachusetts during the past year, and in the light of the board's decision, the continued ability of the demand system to stand the test of time will be an interesting matter to observe.

THE TRACKLESS TROLLEY FOR DUNDEE.

A number of interesting traffic problems have arisen lately in Great Britain, one or two of which we have commented upon. One of the newest, worthy of note not because of its importance so much as on account of the proposed solution, is that described in our contemporary, *Electrical Engineering*, of London. It seems that the city of Dundee feels a strong need for some traffic accommodation on the Clepington road. The traffic there is not sufficient to warrant the expense of a street railway, so that various form of motor buses have been under consideration. After a careful investigation made by a subcommittee of the tramway committee of the Dundee Town Council, during which the subcommittee inspected a number of so-called trackless trolley systems in service on the Continent of Europe, it has submitted a report recommending the installation of such a system on the route mentioned.

It will be very interesting, should the recommendations of the committee be followed, to watch the success of this system. Several years ago there was a good deal of talk about the advantages of the trackless trolley for routes where the traffic is light. But, with the exception of three or four installations in Europe, the decision seems always to have been in favor of a railway.

Among the systems inspected by the subcommittee was that at Monnheim, Germany. This connects Monnheim with the railway station of Langenfeld, the distance being about two and one-half miles. It has been in service for a number of years; when first started the traffic was light, but it has since built up a traffic sufficient to warrant the laying down of rails, which is soon to be done. The result here is precisely what was predicted would happen. The inexpensive trackless system saves the greater part of the expense of the street railway; it thus greatly reduces the risk and determines whether there is sufficient need for a railway. An incidental advantage of the system is that it can be so constructed as to make but slight change necessary in the overhead structure when the tracks are laid.

Another system inspected by the committee was that connecting the towns of Ahrweiler, Neuenahr and Walporzheim. This system was put in service a little over two years ago. In many places the streets are very narrow, the paving is rough, though between the towns the roads are fairly good. The motor-car carries baggage and draws a trailer seating twenty passengers. A speed of fourteen miles an hour is made, and it is said that the actual results show a consumption of energy of only 0.67 kilowatt-hour per mile run. This figure seems very low considering the unfavorable road conditions existing in places and the fact that the motor-car draws a trailer.

Still a third system investigated was that at Mulhausen, where it is said the most recent installation exists. This system was installed to connect the zoological gardens of the town with the electrical line. The company operating the latter said that the traffic was too intermittent to make an extension of its system profitable, and at the same time the grades were too steep for a railway to operate successfully, therefore a trackless trolley system was constructed and put in service during last May. The cars are light and well equipped and have been provided with emergency brakes. The subcommittee was so well pleased with the operation of this line that it recommends that a similar system, somewhat modified, be used for Dundee.

The advantages of the trackless trolley system are its suitability for just such conditions as have been described above. The greatest drawback of the system would be assumed to be the large energy consumption due to the fact that the cars do not run on rails, but if the figure given above is reliable, it is evident that a properly constructed car can be operated over moderately good roads without requiring an excessive supply of energy. The system, of course, avoids the expense of laying a track, and does not add this impediment to other traffic. It does, however, require two overhead wires, since a ground return is impracticable, but the overhead structure could generally be light and placed where it is least objectionable. It is evident, from the report to which we have referred, that very good speeds can be obtained. Fourteen miles an hour is fast enough for such light traffic as could be handled by a system of this kind. Possibly, when the success of these foreign installations is better realized, the system itself will receive more attention elsewhere.

A HIGH-TENSION TRANSMISSION DECISION.

Last March proceedings were begun by the Commissioner of Water Supply, Gas and Electricity of New York city against the New York Central & Hudson River Railroad Company looking to the compelling of the railroad company to place under ground its high-tension feeders supplying current to its electrical zone for the operation of its third-rail system. Hearings have been conducted before the Public Service Commission of the First District. While the commission does not approve of aerial transmission lines, it holds that as long as this line is safe, and the testimony and evidence presented, it avers, did not prove it unsafe, it would seem to be a great injustice to the company to compel it to destroy its present lines, and to place its high-tension transmission system under ground. Other suggestions made by the commissioner are either overruled or modified. The decision, on the whole, is favorable to the company and is an indication that this commission is not prepared to indulge in high-handed or arbitrary procedure.

During the hearings it was shown by testimony that in addition to the high-tension system of the New York Central and the Long Island Railroad system there are at present maintained in the city of New York, presumably under permits from the city, five hundred and thirteen miles of overhead line operating at from one thousand to three thousand volts, and forty-seven miles operating at from three thousand to eleven thousand volts, for electric light and railway service and strung along the public streets.

Ohio Electric Light Association.

Fourteenth Annual Convention, Held at Hotel Victory, Put-in-Bay, Lake Erie, August 25, 26 and 27.

THE fourteenth annual convention of the Ohio Electric Light Association, held at Put-in-Bay, Lake Erie, on August 25, 26 and 27, 1908, combined to a larger degree than ever before in the history of this association the social and the business elements. While the committees in charge of the entertainment features, which were many and varied, performed their duties with good taste, energy and judgment, the business features received equally adequate treatment and full preparation, so that the papers read were pithy and suggestive, and above all brief and to the point, and were business-getters. They brought out in nearly all cases full and free discussion. If the work of an association is to be judged by results in increased membership and better turnout of the membership to the conventions every year, the Ohio Electric Light Association is certainly maintaining its position as one of the best of the state associations in the country.

TUESDAY AFTERNOON SESSION.

Secretary Gaskill called the convention to order at two o'clock on Tuesday afternoon, and announced that in the absence of President F. M. Tait, of the Dayton Lighting Company, ex-President W. P. Engel, of Defiance, would preside during the opening session.

The first order of business was a paper by William M. Adams, of Elyria, Ohio, on "Gas Engines in Central Station Work." Mr. Adams advocated very strongly the employment of gas engines in place of steam where gas is available, on account of the decreased cost of operation, and he gave figures covering four years' experience with these engines.

Mr. Adams stated that his company had run two engines since a year ago last April and had never lost any time during that period. Last spring they remodeled the plant entirely and did not shut down one minute. These were two Westinghouse 280-horse-power, three-cylinder, and one Struthers-Wells of 258 horse-power. They use a single system of ignition, with a duplicate set of batteries so as to provide for a battery giving out.

He said that it takes a good man to run a gas engine. They pay more for gas engineers than for steam engineers when they find the right man. Where they could get a steam engineer for $65 they pay $70 or $75 for a gas engineer. The engine was guaranteed for 250 horse-power, twenty-five per cent overload. It ran twenty-five per cent over the guarantee. During one period of twenty-four hours it ran all the way from 250 to 330 horse-power under water rheostat test.

The next paper was entitled "A Report on Gas Producer and Oil Engine Plants," contributed by B. H. Smith, of the Lexington electric plant.

This paper describes a suction gas-producer plant operated by the Lexington Electric Light Company, Lexington, Ohio. This consists of a twenty-five-horse-power suction gas producer and a 100-horse-power producer gas engine. The dynamo is a seventeen-kilowatt, 125-volt, direct-current machine. The producer is an antiquated type built in 1902, using anthracite coal. With an average load of 10.2 kilowatts, and a run of five and one-quarter hours, 271 pounds of coal are consumed, including a stand-over loss of three pounds per hour. Deducting fifty-six pounds for stand-over, the fuel consumption during the run is 215 pounds, or 2.2 pounds per horse-power-hour or four pounds per kilowatt-hour. With coal at $4.90 a ton, the cost for fuel is one cent per kilowatt-hour. The entire cost, including oil, attendance, etc., is four cents per kilowatt-hour. The preparation of the plant for the run takes about an hour. Oiling the engine, cleaning and timing the igniters, cleaning, barring and blowing the fire in the producer, sum up the usual preparatory service. The engine receives the greater part of the attention necessary during the run. The igniters have given but little trouble. The repairs on the producer have not exceeded $5 per year. The upkeep of the engine will probably amount to $30 per year.

S. E. Folk, of Bryan, said he had been operating a Diesel engine for about a year with entire satisfaction. The economy of the engine has been remarkable, current at the switchboard costing three and one-half to four cents per kilowatt-hour, including interest, sinking fund, labor, fuel and all operating expenses. The maintenance has been much less and the labor less than with the steam engine had previously.

Bonds to the amount of $60,000 were sold for the installation of this plant. There is set aside $500 a month, which will pay the face of the bonds in ten years, and $250 a month for interest; so that it is expected to pay for the plant in ten years. The capacity of the plant is 300 kilowatts. The output varies from 900 to 1,500 kilowatt-hours a day, varying with the demand for motor load. The power-factor during the day is seventy per cent.

WEDNESDAY MORNING SESSION.

President Tait opened the Wednesday morning session and delivered his address, saying in part:

There has been a decided tendency during the past year for competitive electric companies in the same territory to consolidate, thereby effecting what is absolutely necessary for complete business and financial success in a public utility of any sort. It is only by the complete and absolute control of the electrical output in any community that a public service corporation can lower its production and distributing costs and thereby benefit the consumer as well as help itself.

Monopoly does not and can not successfully mean disregard for the public rights and welfare. The lighting company's responsibility increases in proportion to its complete and absolute monopoly of the lighting situation in its territory. The municipal ownership idea seems to be gradually falling behind. Each year is bringing the taxpayer to a better realization of the fact that "the public pays the bills."

Announcement was made by Secretary Gaskill that there was being held coincidently at the same hotel a convention of the Astronomical and Astrophysical Society of America, and suggested that the courtesies of the Ohio Electric Light Association be extended to them. The motion carried unanimously and the chair appointed T. D. Buckwell and L. Clifford Anderson as a special committee to wait upon Professor E. C. Pickering, president of the Astronomical and Astrophysical Society and communicate to him the action taken.

Professor Pickering, director of Harvard College Observatory, addressed the convention briefly and with evident gratification at the kindly reception and applause accorded him.

Professor Lord, professor of astronomy, Ohio State University, was also invited to address the association and returned his acknowledgments.

Secretary-Treasurer Gaskill submitted his report for the year, showing gross receipts of $1,815.56 and disbursements of $1,577.64. He congratulated the associa-

tion upon the very active and successful work accomplished, characterizing the year as the most successful one in the history of the association.

C. R. McKay, of the Toledo Railways and Light Company, presented a paper on "Experience with Luminous Arc Lamps."

This paper describes the installation by the Toledo Railways and Light Company, in February, 1907, of some 547 luminous arc lamps of the General Electric type for series street lighting. This number has been steadily increased, until at the present time about 1,670 lamps are in regular service. The first few hundred lamps were operated from belt-driven Brush arc generators, which machines were gradually removed as the installation of twenty-five-cycle, constant-current transformers with mercury arc rectifiers and switchboard panels progressed. All the street lighting in Toledo is now effected by means of such lamps, which, for the most part, are spaced approximately 600 feet apart in the residence and outlying districts of the city, while in special cases the lamps are nearer together and set upon ornamental iron poles.

The lamps average from 320 to 324 watts per lamp, including line losses, as measured at the direct-current circuit terminals. The present 1,670 lamps, distributed over thirty-seven circuits, are trimmed by three trimmers, each provided with horse and buggy, and about one per cent of the lamps are in the shop as an average for adjustment or minor repairs.

Concerning the life of mercury arc rectifier tubes, there are many which have exceeded 2,000 hours life, and several have exceeded 3,000 hours life. The maximum recorded life of any tube up to June 1 was 3,589 hours and eight minutes. The average life of twenty-three tubes which burned out during May was 1,110 hours.

The chair called attention to the importance of arc-lamp efficiency and invited a full discussion, in the course of which Mr. Glosser (Marion) inquired if the lamps and tubes operated directly on twenty-five-cycle circuits without the use of frequency changers, to which Mr. McKay replied that no frequency changers are used in the operation of these lamps, the twenty-five-cycle current from the turbines being supplied to the constant-current transformers and delivered by them at the same frequency to the rectifier tubes, which in turn change the twenty-five-cycle current to a pulsating direct current.

Mr. McKay said that he doubted whether any motor-generator set would show up an efficiency much better than eighty-five per cent or eighty-six per cent at its full load; whereas the efficiency obtained by the rectifier system, as indicated by the tests given, is considerably higher than that; furthermore, it is to be borne in mind that by the use of constant-current transformers one is dispensing with any additional running machinery other than the generator itself. The attendance required in the operation of constant-current transformers with rectifiers is very little. In the station quoted, having some thirty-four sets, the work of handling the switchboard is done by exactly the same attendants who look after the other switchboard work in that station, which is a station of some 15,000 kilowatts capacity in the various systems. Practically none of their time is spent on the rectifier board except when they are plugging in circuits.

B. H. Gardner, of the Dayton Lighting Company, read a paper on "Best Ways and Means of Getting Out and Keeping Out Private Plants in Central Station Territory."

Mr. Gardner is of the belief that the primary fault to find with central stations is that too many of them still demand excessive rates for their service, these rates being based on quantity only, regardless of the quality of the load. There are still managers who think they can not go below some certain fixed price per kilowatt-hour which may represent average costs, while the truth is that they could afford to take on some kind of business at half the rates they have scheduled. For instance, there was recently a private plant purchased in a large city, although the parties wished to avoid the investment. The load would average from 200 to 300 kilowatts, and would be on from ten to fifteen hours per day. The central station refused to make any concession whatever, insisting on its lowest published net rate of three cents per kilowatt-hour, claiming it would lose money if the business were taken at a lower rate. This stand of the central station, combined with the fact that coal was cheap, explains why one private plant was installed.

To get out a private plant after the plant has once been put in operation is usually a very difficult task. The owner of the plant may be persuaded to close the plant down for a year, using the central station service during that year. It is advisable to take this business for the year's trial at a flat rate, this flat rate to be determined by the costs of the previous year. At the end of the year's test a long-term contract may be entered into at whatever rate the test shows the consumer is entitled to. There are not many people who will go back to a private plant after a year's use of central station service, provided, of course, this service is what it should be.

Mr. Elwell (Sidney) reported that in the case of several factories that were maintaining large steam plants and had their own dynamos he had had difficulty in securing their general lighting business, but had obtained some revenue for their night lighting. In a factory that had something like 200 lights wired up he would give it, say, a thirty or forty-light capacity, limiting the supply by fuse or circuit-breakers so as to avoid getting tied up to the extent of the full capacity, for which he would get no return.

W. C. Anderson reported that they had taken on a planing mill at a flat rate entirely off the heavy lighting hours and where the Edison main passed right by the place. An arrangement can be made with many planing mills not to use power during hours that artificial light is required. Mr. Messer reported that he furnished both power and light for the planing mills at Warren, and they used their refuse under their own boilers to make low-pressure steam for their dry kilns. He had furnished them power for four years.

Papers by J. F. Rothery, of the East Liverpool Traction and Light Company; C. A. Elliott, the Dayton Lighting Company, and H. Engle, Consolidated Gas and Electric Company, Youngstown, were read on the general subject of electric signs, outlining and other special uses of electricity as an adjunct to profitable central station work.

These papers were discussed as an entirety, and some interesting points brought out.

Mr. Buckwell (Toledo) referred to the introduction of motors for ventilating school buildings, an appreciated feature being that they are on from four o'clock in the morning until half-past three in the afternoon. When the school closes the motor is cut out.

Mr. Gaskill reported a similar installation in Greenville. When the schoolhouse was first built two gas engines were installed to operate two blowers, and they gave an unending amount of trouble, first because the janitor knew very little about their operation, second because it is difficult to get reliable small gas-engine

units. The speaker, being on the board of education at the time, on tracing the matter up found that the repairs to the gas engine were running about $80 a year, and besides this a charge for gas. The board of education, after carefully considering the matter, decided to substitute electric motors. They are a strictly day load and average to the company about $10 a month. They have not caused the board of education a cent of expense for repairs since their installation.

In the absence of the author, the paper by F. H. Plaice, of Hastings, Mich., on "How Can We Best Increase Our Business?" was read by Secretary Gaskill.

E. D. Strickland, of Buffalo, Statesman-at-Large of the Rejuvenated Sons of Jove, addressed the meeting on the objects of the order.

Luncheon was served in the convention hall, after which the discussion of Mr. Plaice's paper was taken up.

WEDNESDAY AFTERNOON SESSION.

President Tait commented upon the statement by Mr. Plaice that "under the propaganda the addition is platted and the electric wires strung even before the streets are graded, so that when a house is built the service may be installed from the beginning." It may be a question whether the board of directors of the ordinary company would tolerate such an expenditure of money in advance of the business to that extent, but he believed that the majority of the central stations throughout Ohio are too backward in installing service for those who want it. It is certainly detrimental to install service where one is not going to get an adequate return; but he believed that occasionally it is necessary to stretch a point in order to get new business, and it is always possible to find out certainly just how much line one can afford to build, and if necessary to increase the minimum service charge for a year or two till the place grows up, with the understanding that as increasing numbers of the people connect themselves with the circuit the minimum charge will be reduced in proportion.

W. P. Engel related an instance where a line was erected to outlying territory, the consumer agreeing to pay $200 of the expense of erecting the line, with the understanding that as further connections were made he would be given a rebate; and under a flat rate of $1 minimum and ten cents meter charge per 1,000 watts the result was that in less than a year sufficient houses were connected to enable the company to make a complete refund to the original consumer.

Edward F. Gwynn, of the Delaware Electric Light and Power Company, presented the first of two papers on this question, "Should Central Stations Do Wiring" This was followed by a contribution on the same subject by C. C. Custer, of the Miami Light, Heat and Power Company, of Piqua, Ohio.

Mr. Gwynn, speaking from his own experience and especially in smaller cities of, say, 15,000 population and under, states that his answer to the question, Should central stations do wiring? would be, "Yes." He believes that this is necessary to properly serve and protect the company's patrons. Cities of this size (15,000 population) can support but one first-class wiring and construction establishment, and some cities can not do this. It should be the duty of the central station to look after all new buildings and see that the electrical installation is not being overlooked nor neglected. He believes that in small cities the average citizen has more confidence in the central station and prefers to deal with it rather than with a supply house or contractor.

Mr. Custer is of the opinion that the function of the central station is to generate and distribute electrical energy. It is to the central station's interest that house wiring be well done and the wiring business pushed, but this does not mean that the work must be done by the central station, nor that when so done it will be better wiring. It seems to him that this is a field where the central station should be a co-operator instead of a participator. It is possible to get good wiring done by private contractors, and such contractors should have the moral support and co-operation of the central station. When sure of this support he believes it is generally possible to get a sufficient number of responsible private wiremen to enter the field.

W. P. Engel was strongly of the opinion that central stations, whether large or small, should do wiring and should have a trouble man to look after every little detail of residence, store or factory, and in this way give more prompt service and eliminate kicks that this, that and the other was going wrong. He would charge the consumer for every renewal and every supply part used for repair, but there should be no time charge made in the bill.

Mr. Adams (Lorain) quoted the experience of the gas company in the introduction of gas stoves and the fact that by their going into the plumbing business they had so increased the use of gas stoves that they were now selling thirty per cent of their output for heating and cooking. He inquired why the same policy should not be followed with regard to electric wiring.

Mr. Selig (Mt. Vernon) reminded the convention that last year he had expressed himself in favor of central stations withdrawing from the wiring business and turning it over entirely to the contractors. A year's observation had further confirmed him in this opinion. In this way the central station enlists the assistance of the contractor, which often proves valuable.

Mr. Turner stated that in Cleveland about two years ago they initiated an instalment plan of payments for wiring, the wiring being turned over to certain contractors. The first year some 500 houses were wired, but the company was not satisfied with the general results, and had adopted another plan which gave promise of being more successful, and up to this time about 1,000 houses have been wired under it. It accomplishes results and at the same time keeps the central station out of any liability or responsibility, either legal or moral. The company solicits the wiring of houses under a flat price per outlet. The contract is then turned over to any reliable wiring contractor who will work under this plan, *viz.*, that he must undertake any houses turned over to him whether he makes or loses money on them, and his price for wiring can not exceed the printed schedule of flat rates at so much per outlet. The company gives the consumer credit on his electric light bill for fifteen per cent of the cost of wiring and fixtures up to a total of $15; that is, fifteen per cent on his total bill not exceeding $100 worth of fixtures and wiring. The fixture houses agree to sell fixtures also on the instalment plan of payment. The plan has been working out very successfully during the past year, and the incentive for the man wiring houses to do soliciting is that he turns the contracts over for the wiring of houses on a pro rata basis as to the number turned over to us that he has solicited.

J. S. Codman, of Boston, Mass., presented his paper on "Illuminating Engineering."

Mr. Codman believes that in co-operation with customers there is, at least in the lighting field, a good opportunity to bring down the cost, since the waste by customers, not only in converting electrical energy into light, but also in the use of the light itself, is something prodigious. This continual waste, unrealized by customers, leads to the impression that electric lighting is more expensive than is

actually the case. The result is that many are afraid even to try it, and the growth of the business is stunted. One of the principal objects of the science of illuminating engineering is to prevent, or at least check, this waste, and some knowledge of its principles is of great value to those connected with the central station business. Much electricity is wasted by customers through the use of cheap lamps of low efficiency. This can best be remedied by the adoption of the wise policy of furnishing lamp renewals to customers, either free or at less than the market price. Another prolific cause of waste is the use of dirty lamps. The use of an unnecessary number of lamps is still another form of waste. Another cause, also common in residences, is the failure to make it easy to turn the lights on and off. There are other ways in which light is wasted which are not so obvious, and to overcome which some knowledge of illuminating engineering principles is necessary.

Professor F. C. Caldwell, of the Ohio State University, discussed in an able manner the leading points in Mr. Codman's paper.

D. L. Gaskill, of the Greenville Electric Light and Power Company, presented a report on the experience of central stations with tungsten lamps.

This paper is a recapitulation of the experience of a number of central stations using tungsten lamps for the last six months of a year. From this summary the conclusion is arrived at that the tungsten lamp has been in use for too short a time to judge fully as to its adaptability for general use. The price at present charged is exorbitant and will prevent its coming into general use unless reduced. The life of the lamp is shorter than that claimed by the manufacturers, or it does not permit of a wide range of conditions such as must be met by any lamp in general use. The brilliancy and the economy of the lamp are particularly good. While fragile, it has borne shipment with fairly good results. Discoloring of the lamps has not been bad, nor has such change affected the quality of the light. It is a valuable adjunct in meeting competition, and, where installed in the proper manner, gives excellent results from the illuminating standpoint. The larger units, as now made, are most desirable. Until the price is reduced the most satisfactory method of disposing of them to the consumers is through the supply houses.

George C. Osborn said that this report was convincing of the fact that the central stations in Ohio are enthusiastic users of the tungsten lamp. Considering the five installations as a whole and not in part, there were twenty-six lamps installed, and of this number eight were shown to have burned out, and eighteen, or seventy per cent of the total mentioned, are still burning. The average life of the early burned out lamps equals 397 hours; and the remaining eighteen, or seventy per cent, were still burning at the end of 382 hours. The total amount paid for the tungsten lamps, considering them at a price of $1.65, would aggregate $42.90; the total that would have been paid for carbon lamps would be $13.28, showing a differential of additional cost for tungsten lamps of $29.62. Five new installations were obtained involving the displacement of gas or gasolene at a cost to the central station at the present time of $6.27, eliminating the rental which will accrue from the seventy per cent of the lamps still on circuit. The report indicates that the installations were used on an average of four hours per day, and at a rate of ten cents per kilowatt-hour the income thus far received has been $100. Surely this is making one blade of grass grow where none grew before. Even with the apparent short-life showing made by this central station it can thus be seen that the use of tungsten lamps was of great benefit.

A successful method of satisfying a prospective customer on the life of tungsten lamps is to show him what the minimum life is that the lamp will pay for itself as compared with an installation of the same candle-power obtained with carbon-filament lamps on free renewal basis. In the above report, where the price of the lamp is given at $1.65 the 100-watt tungsten lamp pays for itself in current saved on a ten-cents-per-kilowatt-hour rate in ninety-two hours; and, therefore, in the average life shown above every lamp had paid for itself four times over, and seventy per cent were still in service.

THURSDAY MORNING SESSION.

Secretary Gaskill announced the banquet for Thursday evening, stating that it was free to all, whether active or associate members or guests. He urged a full attendance, as elaborate preparation had been made to make the occasion an interesting and entertaining one.

The nominating committee submitted their report, and at the suggestion of Secretary Gaskill action on same was laid over until just before the noon adjournment, in order that all might have opportunity to consider the nominations made. Later on in the session the report was taken from the table and unanimously adopted, electing the following as officers for the ensuing year:

President, C. R. McKay, Toledo.

Vice-president, J. C. Rothery, East Liverpool.

Secretary-treasurer, D. L. Gaskill, Greenville.

Executive Committee—F. M. Tait, chairman, Dayton; W. P. Engel, Defiance; M. E. Turner, Cleveland; W. F. Hubbell, Wauseon; L. G. White, Columbus.

Advisory Committee—Samuel Scovil, chairman, Cleveland; F. M. Tait, Dayton; D. L. Gaskill, Greenville.

Publicity Committee—E. L. Booth, chairman, Bellaire; W. A. Wolls, Columbus; W. C. Anderson, Canton.

Finance Committee—T. D. Buckwell, chairman, Toledo; L. C. Anderson, Franklin; T. D. Elwell, Sidney.

Membership Committee—W. J. Hanley, chairman, Cleveland; C. B. Rodgers, Tiffin; H. H. Cudmore, Cleveland; G. E. Miller, Cleveland; C. M. Lott, Hicksville.

The chair announced that the discussion on the tungsten lamp would be resumed at this time and called upon F. W. Willcox, of the General Electric Company, Harrison, N. J., to address the convention.

Mr. Willcox said the central station interests have cause for congratulation that the tungsten lamp is available. There are two features of this lamp that should cause all central station men to rejoice; one is that the efficiency obtained has been secured with a simple form of incandescent lamp. This has not been the case oftentimes in the evolution of a science or device; the tendency is generally to run to greater complication. That means a great deal of saving in investment and writing off of old apparatus, because the lamp simply replaces itself in the ordinary course of renewals, and therefore there is no antiquation. The report heard yesterday is also cause for congratulation as showing that in its inception, the lamp only having been six months in service, as shown by these reports, has acquitted itself so well. We have never had in the history of any developments any lamp that has shown the promise and performance that the tungsten lamp has. Other developments, such as the Gem, tantalum and improvements in the arc lamps have required much longer time and caused a great deal more complaint and dissatisfaction before finally arriving at satisfactory condition. It is now up to the central station to adopt some policy that will

insure the lamps being introduced and the consumers given the benefit of it. As far as he can judge it seems that experience so far indicates that the most satisfactory policy will be a monthly maintenance charge for the lamp, which avoids the user having to pay full price of the lamp whenever one burns out.

The twenty-five-watt tantalum lamp should be seriously considered by central stations. This lamp is reasonable in price and, while it has not as large candle-power as the ordinary sixteen candle-power, yet, considering brilliancy, it is fully as satisfactory a lamp as the sixteen-candle-power. It is serviceable and more handy and durable than the tungsten lamp, and in conjunction with the tungsten lamp should find wide use in the improved economy which renders these new lamps necessary. The tantalum lamp has been materially improved in life since its introduction, giving a life on direct current well over 1,000 hours, and on alternating current of sixty cycles or less it is found that the light is about two-thirds of what it is on the direct current. It is reported from abroad that the German manufacturers are at present doing a larger business in tantalum lamps than in tungsten.

J. R. Cravath said that in regard to a question about the equivalent lighting value of the 100-watt tungsten lamps and gas arcs, he had occasion to figure out the probable relative value from theoretical considerations and arrived at the conclusion that under most conditions two 100-watt lamps would easily replace the ordinary gas arc. It would not do it where the gas arc was always maintained under ideal laboratory conditions, but we all know they never are maintained that way; it is a physical impossibility. Unless they are adjusted just right to give the maximum candle-power from hour to hour it can be pretty safely figured that two 100-watt lamps with reflectors will deliver as much useful light in the store as one gas arc.

W. C. Anderson, of Canton, said that in the matter of meeting gas cost, where there is natural gas competition it is absolutely an impossibility to meet the cost of gas; but customers are very glad to pay more money, not only fifty per cent more, but two or three times as much to get a satisfactory light. That has been proven very well, not with the tungsten lamp, because that has only been available a short time, but with other illuminants, the direct-current enclosed arc lamp and the Nernst lamp and the Gem lamp.

President Tait asked Mr. Willcox if it was fair to expect that the tungsten lamp will ever reach a development such that the price will go down proportionately as the price decreased on the carbon-filament lamp? For instance, the latter was bought years ago for $1.25 and they gradually came down to fourteen or fifteen cents during the course of five or ten years.

Mr. Willcox replied that there are so many factors involved that one can not give a definite answer, but from the present outlook it does not seem as if it could; yet that does not mean that something may not develop in the way of a cheapening process that one can not foresee now which will make it possible to bring that lamp relatively as low in cost as the carbon; but central stations must remember that we are dealing with a lamp that runs on one and one-quarter watts per candle instead of three to three and one-half watts per candle, and therefore even at the same cost it is going to be three times as high. Even at the same cost for equal candle-power the tungsten lamp renewal cost per kilowatt-hour will of necessity be three times as high as that of the carbon lamp.

Mr. Osborn said that those central stations that are selling the lamp at a high price are just as aggressive and getting just as many customers as those that are selling cheaper. The subject of rental basis is one that can be scaled down as low as one cares to make it, but the actual selling price of the lamp, if it was reduced in any case ten or fifteen per cent, would not affect its sale. If a reduction in price comes it will be better for a central station to pocket that difference and perhaps be more liberal on the question of early burnouts or trial installations, or a liberal policy generally in handling the proposition rather than to make a corresponding reduction in price which would hardly count for anything. The question of what the life is going to be is often asked; what the minimum life is in which the lamp will pay for itself. A lamp that will cost $1.80 will pay for itself ten times in 1,000 hours, so that it pays for itself at the end of 100 hours' use.

Mr. Gardner said that the Dayton Lighting Company charges a rental for one 100-watt tungsten lamp of twenty cents a month regardless of the number of hours that it may be used. If a man only burns his lamps about two hours a day they would actually get more, taking a basis of 1,000 hours, than it would cost to renew; in other words he would pay for his own renewals. If a man uses his lamps three and one-half hours a day he pays about as much as it costs to renew them on a basis of 1,000 hours. If he burns them ten hours a day it will cost the company about two cents per kilowatt-hour to renew those lamps, and at the same time it is getting eleven cents per kilowatt-hour for ten hours a day service. Twenty-five cents per lamp per month would assure a little better return; burning for five hours per day it would not cost anything for renewals.

H. M. Browne, of the Nernst Lamp Company, described the new Westinghouse Nernst units which are being placed on the market. These new units of single-glower type have screw base renewal and are made in sixty-six-watt, 110-watt and 132-watt sizes, both alternating-current and direct-current, 110 volts; eighty-eight-watt, 110-watt and 132-watt, 220 volts. The efficiency of the new unit on single-glower lamps will range from 1.2 to 1.4 watts per candle, with regular alabaster globes; on the multiple-glower, from 1 to 1.25 watts per candle, depending on the size of the lamp. On the holder of the multiple-glower type lamps we have a wafer heater. This wafer has a longer average life than a heater tube and costs very much less.

D. L. Gaskill read a paper on "Some of the Causes of Failure in Municipal Lighting Stations."

L. Clifford Anderson, of the Franklin Electric Light Company, read a paper on "Grounded Alternating-Current Secondaries."

E. F. Creighton, of the General Electric Company, delivered a very interesting address on the subject of protection from lightning, describing the many measurements made to determine the phenomena and effect of the current induced by lightning discharges and bringing out the main features of the new types of lightning protective devices which have been placed on the market.

After discussion and some routine business a recess was taken until 2.15 P. M., when the paper entitled "Gas and Gasolene Lighting Competition and Best Ways to Meet It" was read by Fred Leslie, of the Muncie (Ind.) Electric Light Company.

There was some further desultory discussion and the convention adjourned to meet when and where it may hereafter be determined by the executive committee.

One of the interesting events of the convention not upon the regular programme was the Rejuvenation of the Sons of Jove on Wednesday evening. The initiation was in charge of Jupiter H. H. Cudmore, of Cleveland, Ohio, and States-

man-at-Large E. D. Strickland, of Buffalo, N. Y. The Sons of Jove now number over 1,700. The initiates were: Charles L. Bogner, Cleveland Electrical Supply Company, Cleveland, Ohio; William A. Baker, American Electrical Heater Company, Detroit, Mich; William R. Collins, New York & Ohio Company, Warren, Ohio; F. R. DuGuay, Erner Electric Company, Cleveland, Ohio; H. O. Dutter, Bucyrus Gas and Electric Company, Bucyrus, Ohio; F. L. Finch, Union Electric Company, Pittsburg, Pa.; Warner Jones, Cleveland Electrical Supply Company, Cleveland, Ohio; T. J. Smith, New Lexington Electric Company, New Lexington, Ohio; E. L. Van Winkle, Post-Glover Electric Company, Cincinnati, Ohio; F. A. Williams, chief engineer Hotel Victory, Put-in-Bay, Ohio.

The annual meeting of the Sons of Jove will be held in Buffalo, N. Y., on October 15 and 16, 1908.

The entertainment committee arranged a number of interesting events for the attending ladies and delegates. Dances were held on Tuesday and Wednesday evenings; a progressive euchre party and a bowling tournament for the ladies on Thursday morning, and a vaudeville performance on Thursday evening, with volunteer talent. The ladies were also conducted on a trip through the caves. Music and songs were rendered on Wednesday evening by a colored quartette.

The following companies made exhibits:

Allis-Chalmers Company; represented by F. C. Colwell, Cincinnati, and S. Wolff, Cleveland, Ohio; exhibiting polyphase and direct-current motors, autostarter and transformer, rotating part of steam turbine showing internal construction.

Diamond Rubber Company; Edwin Williams, sales manager; large-sized National Electric Code cables; issued an attractive postal card.

Duncan Electric Manufacturing Company; Adrian Tobias, sales manager; showed a line of integrating watt and test meters.

The General Electric Company was represented by H. C. Houck, C. R. Wallis, Cincinnati; W. J. Hanley, H. B. Goodloe, Cleveland; L. R. Dunkle, Columbus; G. H. Stickney, Lynn, Mass.; George C. Osborn, F. W. Willcox, Harrison, N. J.; E. F. Creighton, R. E. Russell, Schenectady, N. Y. The exhibit especially emphasized the latest developments in tungsten diffusers. There was an interesting layout of tungsten lamps for church installation, showing fixtures with units grouped in an artistic way; also photographs of other unique fixture designs. Another feature was a new lamp-testing watt indicator for the purpose of making ocular demonstration to prospective customers of the relative watt consumption of metallic and carbon-filament lamps.

The Holophane Company; A. C. F. Keleher, New York; J. S. Codman, Boston, Mass.; line of new prismatic reflectors, giving ten per cent increase of candle-power; concentrators used for window lighting with very high ceilings.

The Ideal Electric and Manufacturing Company; Clarence E. Delafield, S. E. Huenerfauth, Mansfield, Ohio; new single-phase motor.

H. W. Johns-Manville Company; R. R. Braggins, manager electrical department, Cleveland, Ohio; exhibiting insulating material, fuse devices, "Linolite," service and subway boxes, friction tape, etc.

National Metal Molding Company; V. F. Gates, Cleveland, Ohio; metal molding.

Nernst Lamp Company; Max Harris, Pittsburg, Pa.; H. M. Browne, manager, Detroit, Mich.; showing new screw burner Westinghouse-Nernst lamp, made in four sizes, from fifty to 125 candle-power.

New York & Ohio Company; William R. Collins, Warren, Ohio; advertising literature.

The Sterling Electrical Manufacturing Company; W. F. Benedict, J. T. Donahue, Warren, Ohio; presented all comers with souvenir rules, tape measures, handsome celluloid blotting pads, etc.

Wagner Electric Manufacturing Company; Thomas T. Richards, St. Louis, Mo.; Dean Emerson and Paul Sentman, Cincinnati; switchboard instruments, etc.

Western Electric Company; George H. Porter, sales department, Chicago, Ill.; F. M. Shely, Cincinnati; arc lamps and Sunbeam tungsten lamps.

Westinghouse Electric and Manufacturing Company; J. W. Schrantz, Cincinnati; C. E. Miller, R. D. Nye, George S. Vail, Cleveland; H. H. Hughes, Columbus; Charles H. Davis, L. A. Starrett, S. A. Fletcher, J. O. Little, W. B. Wilkinson, Pittsburg, Pa.; fan motors of various sizes, electric irons and heating apparatus, glue pots, meters, etc.

The Ambos-Cudmore Company; H. H. Cudmore, Cleveland, Ohio; Weston Electrical Instrument Company apparatus, Eclipse voltmeters and ammeters, oil switch, Condit oil circuit-breakers, flexible conduit, etc.

The Adams-Bagnall Electric Company; represented by A. J. Mitchell, Cleveland, Ohio, who distributed court-plaster.

The Sanitary Pump Company; duplex reciprocating power pump operated by electric motor, manufactured for pressures up to 150 pounds, and in sizes up to 1,000 gallons per hour.

The Pittsburgh Transformer Company; ten-kilowatt Pittsburgh transformer, with silico-vanadium steel core.

Invincible Electric Renovator Sales Company, Cleveland; apparatus in operation sweeping the carpet in the hotel lobby.

Among other manufacturers and supply and material men in attendance were the following: American Electrical Heater Company; W. A. Baker, B. H. Scranton. American Electrical Works. American Shipbuilding Company, J. E. Ginn. Benjamin Electric Manufacturing Company; H. E. Watson. The F. Bissell Company; Fred Bissell, Frank M. Knierim, A. J. Gray, Joseph E. Lockwood. Bryan-Marsh Company; Fred W. Godfrey. Central Electric Company; W. D. Dunsmore. Cleveland Electrical Supply Company; L. Greisser, sales manager; Warner Jones. Doubleday-Hill Electric Company; Elliott Reynolds, W. D. Shaler. S. K. Elliott Electrical Company; S. K. Elliott, C. P. Billings. Electrical Appliance Company; F. J. Anderson. Erner Electric Company; F. R. DuGuay. Erner & Hopkins Company; H. B. Rogers, William A. Hopkins. Fort Wayne Electric Works; George B. Edgar, A. A. Serva. Federal Electric Company; James M. Gilchrist. Globe Electric Company; J. E. Swisher, A. B. Flagg. Hall Gas Engine Company; Marvin E. Hall. F. D. Lawrence Electric Company; Charles E. Kuntz. McKeever Electric Company. W. N. Matthews & Brother; V. L. Crawford. W. G. Nagel Electric Company; Harry E. Adams, A. I. Carney. National Carbon Company; N. C. Cotabish, A. G. Summerell, A. B. Pyke. Post-Glover Electric Company; Edwin L. Van Winkle. Robertson Electric Company; E. D. Strickland, manager publicity department. Standard Underground Cable Company; Le Loyne L. Parkinson. A. L. Swett Electric Light and Power Company; Arthur J. Howard, manager. Toledo Electric Company; Charles E. Yost. Union Electric Company.

French Cable Company Fined in Venezuela.

The Civil Court of the First Instance at Caracas, Venezuela, has handed down a judgment declaring the French Cable Company guilty of complicity in the Matos revolution against President Castro. The company is condemned to pay damages of nearly $5,000,000 and a further amount to be assessed later by experts. The company will probably appeal.

THE TEST-METER METHOD OF TESTING SERVICE METERS—IV.

BY JOSEPH B. BAKER.

COMMERCIAL TEST METERS OF THE MOWBRAY TYPE—THE GENERAL ELECTRIC AND FORT WAYNE TEST METERS.

It should be stated at the outset that by "test meter of the Mowbray type" is

FIG. 7.—THOMSON HIGH-TORQUE INDUCTION TEST METER.

meant any specially constructed test meter of the type described in former articles having a number of field coils giving equal torque for any given percentage of full load on each coil, thereby enabling the meter to be used for testing through a wide range with constant high accuracy. Test meters so designed and used are to be distinguished from "portable standard" meters, either of ordinary construction and fixed capacity, as employed in the early days of meter testing, or of special construction and variable capacity, as exemplified in the Westinghouse portable standard integrating wattmeter. In using the term "Mowbray type" the author does not mean to pronounce upon the matter of priority of invention, patent rights, etc.

ADVANTAGES AND COMMON FEATURES.

The General Electric Company and the Fort Wayne Electric Works are now putting out alternating-current test meters of the Mowbray type, which will be described in the following. Only the individual features of each will be dwelt upon in text and illustrations. For general discussion of the test meter the reader is referred to the matter on preceding pages.

In introduction, it may be well to rehearse very briefly the need which the test meter fulfils in the testing of consumers' meters, and the advantages claimed for the Mowbray type, the fundamental features of design which must be incorporated to obtain these advantages, and the features of operation common to all makes.

In regard to the need filled by the test meter, it is only necessary to call attention to the enormous increase in the number of consumers' meters in service and the higher standard of accuracy in the measurement of electric energy which is now insisted upon in modern central station companies.

While the General Electric and Fort Wayne test meters (see Fig. 7 to Fig. 15) differ in details of design and features of operation, certain fundamental features of design are common to both.

The most important is the composite field winding for obtaining a wide range of operation at maximum precision by securing a high torque in the moving element, constant for every field winding—*i. e.*, the same for any given percentage of full load on one winding as for the same percentage of full load on every other winding. Thus it is claimed for one of these test meters that the torque when using the smallest coil with one ampere passing is equal to that produced by using the largest coil with twenty amperes. The disposition and range of the composite winding and the method of effecting its various connections in order to adapt the test meter to the testing of different capacities of consumers' meters, differ between the two manufacturers.

Another important fea- [illegible] electrical [illegible] of starting and stopping the test meter—by a switch in the potential circuit.

The use of a register for counting the revolutions of the test meter against the revolutions of the meter under test is the outgrowth of the simple disc and pointer of the earlier test meters. While differing in actual design, the register is in both cases of simple (horizontal) form, with three dials, giving sufficient range of registration for practical testing purposes. It is located in the top of the test meter, with good-sized dials adapted for easy reading. The main dial is divided into hundredths, and its pointer is fixed directly on the meter shaft.

Portability of the test meter and accessibility of its parts have been sought. In both makes a neat carrying case, with lock and strap, are provided, and considerable ingenuity has been exercised to facilitate inspection and repairs. The arrangement of keeping the moving element out of contact with the jewel in transportation is regarded as a necessary feature of the test meter as a portable piece of apparatus. A simple and positive "locking device," operated by a thumbscrew, is employed.

FIG. 8.—WORKING PARTS OF THOMSON HIGH-TORQUE INDUCTION TEST METER.

In regard to the bearings, the manufacturers have realized the importance of providing minimum friction and maximum durability in order to maintain the maximum ratio of torque to mechanical friction. Both the General Electric and the Fort Wayne test meters of the present day are equipped with spring-supported cup-diamond jewel step bearings and removable pivots. The top bearings and shaft construction, however, differ in the two makes. The usual care in providing damping magnets of the greatest strength consistent with permanency, and a moving element of minimum weight are exercised in these test meters as in other modern commercial meters.

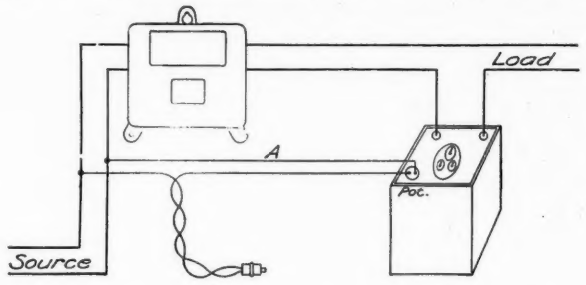


FIG. 9.—CONNECTIONS IN USING THOMSON HIGH-TORQUE INDUCTION TEST METER.

Certain other features of the several

commercial test meters, as meters, are common to all makes.

The operation of both the General Electric and Fort Wayne test meters is the same and may be described briefly as follows:[1]

The test meter should be placed convenient to the consumer's meter and the rotating element lowered onto the jewel. After making the proper connections for test meter and consumer's meter and ascertaining by temporarily starting the test meter (by closing the switch, which is in the potential lead for alternating-current meters) that its disc rotates in the counter clockwise direction, a reading of the register should be taken. Or, the main pointer may be brought to zero by manipulating the switch. The test meter should be started for the test simultaneously with the beginning of the count of the revolutions of the consumer's meter, and stopped after the desired number of revolutions has been taken. The register should then be read again, and the difference between the readings will give the total number of revolutions. The watt-hours registered by each meter are simply the product—quickly obtained on the slide rule—of its respective revolutions and calibrating constant. Since the constant is the watt-hours registered per revolution, the relative accuracy of the meter under test is shown by the ratio of the watt-hours registered by the two meters. A sufficient number of revolutions should be taken to make negligible any error in reading the test meter. As already stated, after the test has once been started it need not be stopped until the desired number of revolutions has been taken, as any change in the external circuit affects both meter under test and the test meter equally.

In checking the test meter the same rules are followed as in testing standard meters, with the possible exception of the formula, which, with the constants usually furnished with the test meter by the manufacturer, becomes:

$$\frac{3600 \times \text{revolutions} \times \text{calibrating constant}}{\text{seconds}} = \text{watts registered by test meter.}$$

Fig. 10.—Calibrator with Cover Open.

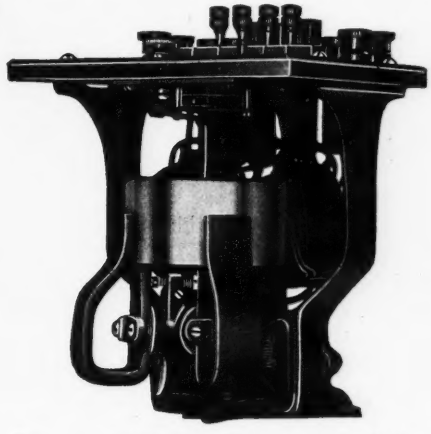


Fig. 11.—Calibrator Removed from Case.

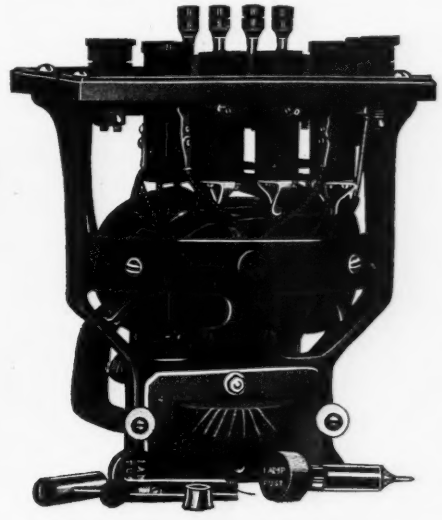


Fig. 12.—Back View of Calibrator Removed from Case.

Calibration of the test meter is most readily done in the test room by the indicating-instrument and stop-watch method, the necessary adjustments being made in the same way as in the regular consumers' meters of each manufacturer; any special devices are described.

GENERAL ELECTRIC COMPANY TEST METER.

The Thomson high-torque induction test meter, type IB-2, manufactured by the General Electric Company (Fig. 7 to Fig. 9), is designed for testing 110-volt alternating-current meters of three-ampere to twenty-five-ampere normal capacity.

Special features of this test meter, described in detail below, are the simplicity of the connections to the test meter and of the general design, extremely high torque, astatic magnet system, and special calibrating devices.

The test meter is contained in a case nine and one-half inches by eight inches by seven inches, with hinged cover. The register has three dials and the ratio between gears is ten to one, so that the second dial reads in units and the third in tens of revolutions. The units and tens dials are placed inside the main dial. The standard three-dial register permits a three-minute test at full load to be made, as the full-load speed of the test meter is lower than thirty-five revolutions per minute. No current leads for connections between test meter and consumer's wiring are provided, but the potential circuit is wired to a receptacle in the top plate of the test meter, and a flexible lead is provided having a plug at one end for inserting into the receptable and a pendent snap switch near the other end by means of which the potential circuit may be closed and opened from a distance.

As shown in Fig. 7 and Fig. 8, the test meter is assembled on a central frame hung from the plate which forms the top of the test meter when the cover of the case is opened. The register dials are in the middle, and along the rear edge are four heavy binding-posts for the current connections. The binding-posts are of simple and rugged pattern, adapted for making "solid connections" with ordinary wire leads. A little to the right of the dials is the thumbscrew for the locking device, and at the left is the receptacle for the potential plug. By means of a pair of buttons, one at each side of the top plate, the test meter may be lifted bodily from its case to make it accessible for calibration or repairs. As shown in Fig. 8, when removed from the case the test meter may be set down resting stably, in a vertical position, on the botton rib of the frame casting. The single-potential winding with which the test meter is equipped may be used on voltages ranging ten per cent on either side of normal (110

[1] The appropriate current coil—*i. e.*, the coil of capacity nearest approximating the load under which the consumer's meter is being tested—should be connected in series with, and between, the meter under test and the load, and the potential coil should be connected across the line between the mains and the meter under test.

volts). There are three current coils, one end of each being connected to a common binding-post, and the other ends to each of the three remaining current binding-posts, marked with the respective ampere capacities of the coils, one, ten and twenty.

In general construction, the Thomson high-torque induction test meter compares well with any make of test meter, as may be seen without need of lengthy description, by an inspection of Fig. 8. Calibrating on full load is effected by loosening the two clamping screws that hold the magnet shoe and then moving the magnets bodily. This illustration shows the general accessibility of the parts. Light-load adjustment is obtained in the usual way by moving a lever at the bottom of the test meter to the right or left, thereby shifting a small rectangular conductor in the space between the potential winding and the disc; the distortion of the flux thus produced accomplishing the desired result without affecting the full-load calibration. The top bearing is a simple hole drilled in the bottom plate of the register.

It is stated by the maker of this test meter that it possesses a constant accuracy throughout a range of 200 to 1, *i. e.*, from a two-kilowatt load down to a ten-watt load, and that negligible error is introduced by ten per cent changes in voltage or frequency.

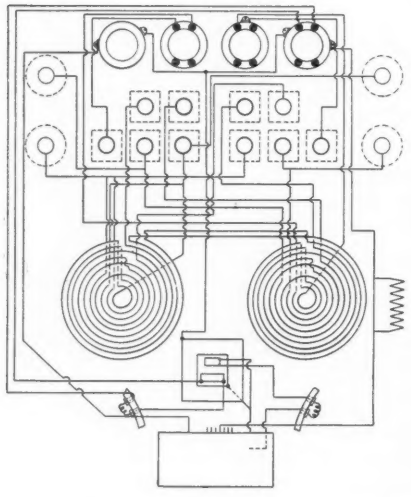


FIG. 14.—WIRING OF CURRENT-COIL SECTION TO PLUG SWITCH.

The correct connections of the Thomson high-torque induction test meter for testing a regular two-wire, three to twenty-five-ampere type I Thomson high-torque induction meter are shown in Fig. 9. The testing procedure is the same as already described in the general discussion of commercial test meters of the "Mowbray type."

THE FORT WAYNE ELECTRIC WORKS TEST METER.

The Fort Wayne type of test meter, the portable wattmeter calibrator, type KM-1, manufactured by the Fort Wayne Electric Works, is one of the most recent additions to the growing family of test meters.

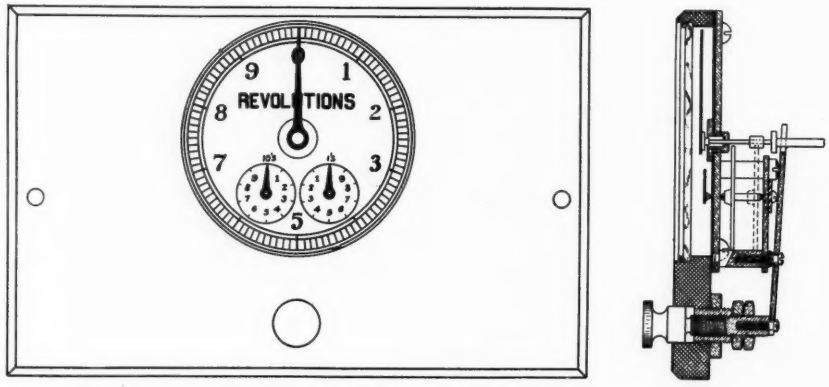


FIG. 13.—REGISTER MOVEMENT AND DIAL OF CALIBRATOR.

This "calibrator," which is shown in the general views, Fig. 10 to Fig. 12, is designed for testing alternating-current meters, covering the range of most 110-volt and 220-volt meters in service on two-wire and three-wire circuits from light load to full load. Special features of the calibrator, described in detail below, are its wide range, the plug-switch method of cutting in the different field-winding combinations, the provision of fuses to protect the one-ampere field winding from accidental overloads, the use of the Fort Wayne type of "cap" instead of the flat disc that is employed in meters of other types, and the general accessibility of the calibrator.

The calibrator is contained in a mahogany carrying case eight inches by eight inches by ten and three-quarters inches. The register (Fig. 10 and Fig. 13) is in the front section of the top plate, and consists of a main dial two and three-quarters inches in diameter, and two smaller ones within the main dial. The ratio between gears is ten to one, so that the second dial reads in units and the third in tens of revolutions. Flexible current and potential leads are provided, the former being a four-conductor cord with punched meter terminals at one end and cable connectors at the other end, all stamped with distinguishing letters to facilitate the making of correct connections with the calibrator and the consumer's wiring, respectively; and the latter a two-conductor cord with a pendent snap switch cut in on it for closing and opening the potential circuit of the meter, and having plugs at one end for connection to the potential receptacles on the meter and spring clips at the other end for connecting to the line. One of the cable connectors of the current leads and one of the line connectors of the potential leads are stamped plus (or minus), to facilitate the correct poling of the calibrator.

Referring to the illustrations, the calibrator is fitted with a hard-rubber top plate, in two sections, which contains all of the devices used in the operation of the calibrator in the testing of meters.

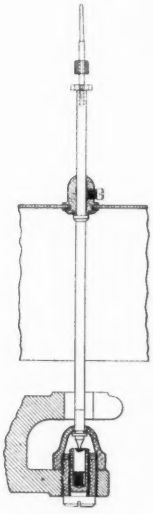


FIG. 15.—STEP-SHAFT BEARINGS.

The front section, which contains the register, as already described, is supported by the frame of the meter, which in turn is supported on the bottom of the carrying case. Directly in front of the register is located a knurled thumbscrew for

operating the "locking device." Turning this screw to the right raises the rotating element and locks it firmly for transportation, out of contact with the jewel, and turning the screw to the left lowers the rotating element onto the jewel. The rear section which is supported by the frame, like the front section, contains the four current binding-posts (two at each end of the plate) and the two potential receptacles (in the middle of the plate) one for use on 110 volts and the other for use on 220 volts, both provided with caps to prevent dust from entering the calibrator when the plug of the potential lead is removed. On each side of the potential receptacles is a receptacle for a one-ampere fuse, consisting of a piece of ordinary fuse wire mounted in a fuse chamber of special design. The front middle part of the plate is occupied by the plug switch which is used for effecting the various combinations of the two current coils with which the calibrator is equipped to give the latter the necessary range of capacity. The current coils are wound in sections which may be connected by means of the plug switch in series, series parallel, or parallel in conjunction with the cable connectors on the current leads. The wiring of the current-coil sections to the plug switch is shown in Fig. 14. The windings selected as most suitable for meter testing are of one, two, five, ten and twenty-ampere and 110 and 220-volt capacity. With these windings meters up to and including twenty-five amperes, two wires, either 110 or 220 volts, and up to and including twelve and one-half amperes, three wires, 220 volts, may be tested.

The top and step-shaft bearings are shown in Fig. 13 and Fig. 15. The top bearing is located in the top plate of the register and is easily accessible by removing the glass, which is held in place by a spring brass ring and the pointer over the large dial. The top bearing may then be unscrewed for inspection. It consists of a simple brass stud tapped into the register plate and drilled for the reception of the upper end of the shaft.

As already stated, accessibility is a feature of this test meter. The entire meter may be lifted out of the case by removing the screw under the strap in the bottom of the case. All of the connections are made on the rear section of the top plate, so that the register and rotating element may be removed without interfering with the connections or altering the calibration. The shaft is made in three sections as shown in Fig. 15, the top-bearing pivot, the shaft proper and the jewel pivot. The joint between the top-bearing pivot and the main portion of the shaft is made just below the bottom plate of the register.

The Care and Maintenance of Storage Batteries.

If the operator in charge of storage batteries, says F. A. Warfield, will always remember that his batteries will do so much in a given time and no more; that they must be used and treated as carefully as an engine and generator; that any attempt to make them do more than the company which furnished them guaranteed will only involve failure, dissatisfaction and expense, he will have mastered the substance of the best set of instructions for their care. A potential of 2.15 volts per cell is required to start the charge and the author has usually obtained the best results by charging at fifteen per cent above the normal rate, maintaining this rate until the voltage reaches approximately 2.5 per cell. At this point the current should be reduced to the normal rate and the charge continued until the voltage stops rising. When charged in this way the voltage will rise rapidly from 2.15 to 2.25 during the first hour, then slowly until 2.45 volts per cell is reached, then it jumps to nearly the maximum value, at which point it remains practically constant, giving off gas freely at the positive and negative plates, while the solution remains perfectly clear. Under ordinary operating conditions a battery may be considered fully charged when the voltage reaches a constant value, but at least once a week this method of determining the state of charge should not be relied upon. There are three ways of determining when a battery is fully charged: When the voltage reaches a constant value; by the color of the plates, and by the specific gravity of the electrolyte reaching a maximum constant value. It is very important that the battery be fully charged, but it is just as important that it be not overcharged, and to prevent this the specific gravity of the individual cells should be taken at least once a week with a hydrometer as a check upon the voltage readings. Usually a charge twenty per cent in excess of the normal discharge is required. And about once in two weeks an overcharge should be given. This is done by charging normally until the full charge has been given; then the current should be dropped to one-half the normal rate and continued for three or four hours. While doing this the specific gravity will be found to rise for an hour or more after the voltage has become practically constant and the overcharging should be continued until the specific gravity itself becomes constant. If, in case of an emergency, it becomes necessary to charge more quickly than usual, the charge may be started at twice the normal rate and continued until the battery commences to gas and the voltage reaches 2.6 per cell. At this point the electrolyte will have a milky appearance and the battery will be gasing freely. The current should then be reduced to one and a half times the normal rate and the charge continued until the voltage reaches 2.6 again, when the charging current should again be lowered. When a battery is used spasmodically or is kept floating on the line it is a good plan to discharge it at least once every two weeks and then overcharge. The temperature of the cells should never be allowed to go above 100 degrees Fahrenheit, the temperature of the cells near the middle of the battery being watched to prevent this. The best results are obtained when charging with the temperature between seventy and ninety degres. The electrolyte should be maintained at least one inch over the tops of the plates and the specific gravity should be between 1,200 and 1,225 when fully charged. The following rules should be observed: Never discharge a battery below 1.75 volts; never adjust the specific gravity by adding acid until the cause of the low specific gravity is known; never allow the acid to get below the standard level; always maintain the acid at the standard specific gravity; never let the battery stand in a discharged condition; at frequent and regular intervals give the battery a good overcharge at a low rate; keep the battery and all connections clean; keep all connections tight; remedy all trouble immediately, and use only pure water and pure acid for the electrolyte. —*Electric Journal (Pittsburg), August.*

The Telephone in Advertising a Play.

During the week a novel use was made of the telephone directory in New York city to advertise the play "Paid in Full." The scheme was to call up every regularly listed telephone subscriber and use a set form of message in apprising the called party of the play and an invitation to be sure to see it. In elaborating the scheme lists of the newly arrived guests at all the leading hotels were secured, and they, too, were reached by telephone.

The Korn System of Image Transmission.

A Detailed Description of the New Apparatus.

By C. L. Durand.

IT will be remembered that Dr. Korn brought his image-transmitting apparatus from Berlin to Paris last year, where it was set up in the offices of the illustrated weekly *L'Illustration* in order to make a public demonstration as to sending the photographs over a wire, and this was quite successful over a long-distance line. Since then the journal decided to take up Dr. Korn's system on a practical scale for newspaper work, and it accordingly had a set of improved apparatus constructed by the Carpentier firm, the successors of Ruhmkorff, who are noted for instrument work on the Continent. One of these instruments is now set up in the building of *L'Illustration* at Paris, where it occupies a special laboratory devoted to this purpose, with a dark room for developing the photographs which are received. The corresponding instrument is in operation at London in the office of the *Daily Mail*. The Paris apparatus is also in connection with one of Dr. Korn's instruments which is set up at Berlin. The transmission between Berlin and Paris is all that can be desired at present and a transmitted photograph of Dr. Glatzel, who is in charge of the Berlin station, is shown herewith. Owing to the compensating selenium method, which is one of the original features of Dr. Korn's method, the details of the photographs are reproduced with great clearness, and the views can be sent within a reasonable length of time. The line between Paris and London includes a telephone cable across the channel, and owing to the inductive effects of the cable the results have not as yet been all that might be expected, but it is hoped to secure a good transmission in the near future.

The station at Paris is in charge of Jules Chatenet, who has kindly furnished the writer with the following points about the new apparatus. Dr. Korn's compensating method, which has not been well understood up to the present, is here described in full, and it is of great interest from a physical standpoint as well as of a considerable practical value. No doubt it will be used in the future by all inventors who are at work upon image-transmission devices. There seems nothing left to be done in the way of transmission of photographs, as Dr. Korn has now solved the problem in a thoroughly practical manner and with remarkable results, but there still remains the attractive and difficult problem of direct vision at a distance, which is far from being solved at the present time.

Each of the complete apparatus contains a transmitter and receiver, and these are mounted side by side upon a suitable support with a motor placed underneath. By changing a lever, the motor mechanism is made to drive either the transmitter or the receiver.

REPRODUCTION OF ELECTRICALLY TRANSMITTED PHOTOGRAPH.

Referring to the outline diagram of the transmitting apparatus, which is shown in Fig. 1, the beam of light is furnished by a lamp which is enclosed in a sliding tube L. For this purpose a Nernst lamp is preferred. By means of a large lens M, placed in front of the lamp, the beam is sent along the chamber to the left, where it reaches a second sliding tube B. This tube contains a lens and at the farther end is a small diaphragm opening which allows a beam of very small size to pass through. The photographic film or positive image which is to be transmitted is wrapped around a glass cylinder A, and this is rotated in a regular way by means of the shaft E. The synchronous motor is made to drive the vertical shaft by means of a suitable mechanism. At the same time the shaft is raised gradually by a screw thread which it carries at the lower part, thus giving a rotating and a vertical movement to the cylinder after the manner of a phonograph cylinder. In this way the beam of light is made to cover all parts of the photographic film. Generally a positive film is used for the transmission, as this will give a negative image at the receiving end. However, a negative film can be employed if desired, in which case the effect is reversed. After passing through the film the beam is received in a total-reflecting prism C, which directs it vertically and allows the light to fall upon the selenium cell D, the light being diffused over the whole surface of the cell. In this way the opaque or transparent parts of the film come into the path of the beam and this action causes more or less of the light to be stopped off. The selenium cell thus receives varying intensities of light which correspond to the different portions of the photographic film.

The receiving apparatus (Fig. 2) is mounted parallel to the transmitter and, like it, consists of a main horizontal chamber with a vertical chamber at one end which receives the rotating cylinder. The mounting of the lamp tube L and the lens M is the same. From this point the beam passes along the chamber and first traverses the galvanometer device W, which is used for cutting off more or less of the beam, according to the amount of current passing in the line. The prism F is not in use when the receiver is being operated, and in this case it is moved to one side and out of the path of the beam so that the light is made to pass through the diaphragm opening E and the adjustable tube D, which contains a lens for concentrating the beam upon the receiving cylinder. The latter cylinder is shown at A, and it is considerably smaller than the transmitting cylinder. Around it is placed a sensitive photographic film which receives the beam, narrowed to a point by a diaphragm. Means must be provided to keep the cylinder A in the dark, after the manner of a roll holder. This is carried out by a tight box B, which con-

tains the cylinder, and the shaft which rotates the cylinder is connected by a coupling piece K to a short piece of shaft which passes through the bottom of the box. As the cylinder has an upward movement like that of the transmitter cylinder, there is provided a long sliding

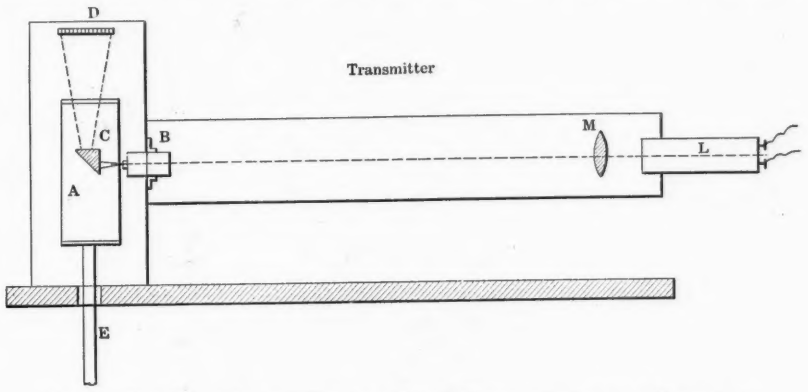


FIG. 1.—THE KORN TRANSMITTER FOR IMAGE REPRODUCTION AT A DISTANCE.

cover CC which is permanently fixed on the end of the tube D and it runs in a groove in the box so as to keep it always covered. There is also a slide which is placed on the box between the cylinder and the tube D (not shown here), so that

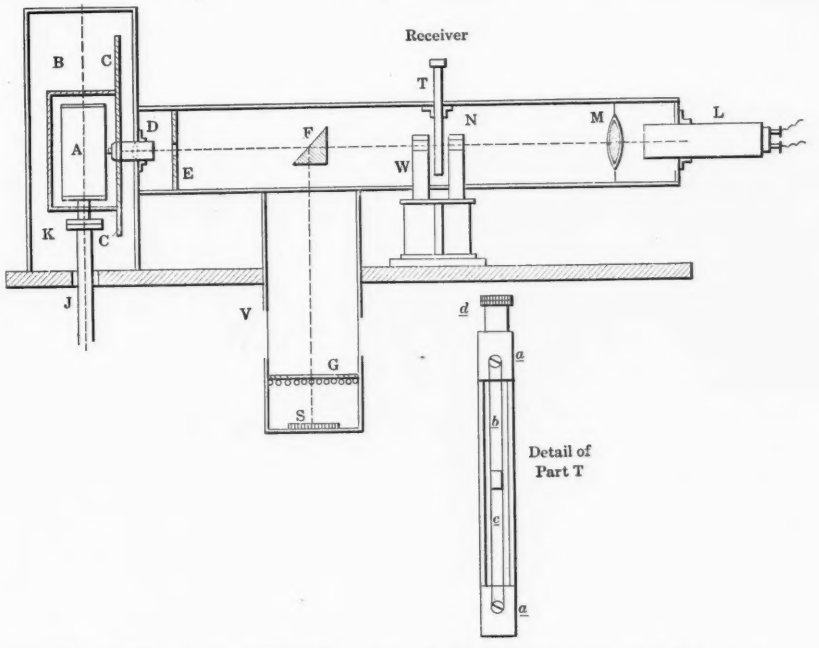
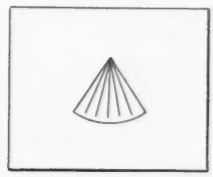


FIG. 2.—RECEIVER OF KORN SYSTEM OF IMAGE TRANSMISSION AT A DISTANCE.

by closing it the box as a whole can be removed for developing the film.

For intercepting a greater or less amount of light, according to the current sent into the receiver, a device which was designed by Dr. Korn is used. It is shown at W, and consists of an electromagnetic shutter which has a small screen moving back and forth in the path of the beam. The movable part T is inserted from the top and lies between the poles of the strong electromagnet N. Openings in the poles allow the beam to pass through. Referring to the detail view of the part T (this can also be seen in one of the photographs), it consists of a supporting rod *a a* upon which is mounted a double stretched wire *b*. For this purpose a fine platinum wire is used. In the middle is mounted a small square of aluminum foil which is exceedingly light. The current coming from the line is made to pass in the platinum wire, and as it is placed in the strong magnetic field the system is displaced to one side and away from the centre as the current passes. The amount of the deflection depends on the strength of the current, but it is not proportional to the latter, as will be mentioned further on. The lack of proportionality is compensated for by a diaphragm placed in the path of the beam at E, which has a triangular opening, so that the amount of light falling on the photographic film is nearly proportional to the current in the line; that is, to the amount of light which has passed through the varying parts of the original image, causing the resistance of the selenium cell to vary in the usual way. Hence, for each part of the original image, light or dark, we have a corresponding resistance of the selenium cell and a corresponding current in the line, giving a greater or less amount of movement to the electromagnetic shutter and hence a corresponding impression on the receiving film.

The portion of the apparatus shown at V, including the prism F, does not properly belong to the receiver, but is used in connection with the transmitter when the receiver is not working. This part



TRIANGULAR DIAPHRAGM PLACED BEFORE THE LENS TUBE (AT E) FOR CORRECTING THE LACK OF PROPORTIONALITY IN THE ELECTRO-MAGNETIC SHUTTER.

forms the compensating device which is one of the most ingenious parts of Dr. Korn's apparatus. It is found a great advantage to use a second selenium cell in connection with the main cell in order to overcome one of the main difficulties which is found in the use of selenium, that is, the "inertia" of the cell. As is well known, the cell does not respond at once to the effect of the light which falls upon it, but there is a certain interval of time, or lag, in the change of resistance which takes place. Again, when the light is removed the cell does not come back at once to the original state. This inertia of the selenium has been a serious drawback in the use of selenium cells for the transmission of images, both as concerns the sharpness of the image and the rapidity of transmitting. In order to overcome the effects of the inertia Dr. Korn uses a second selenium cell which is connected electrically with cell No. 1, both cells being placed at the sending station. Cell No. 2 receives light at the same time as No. 1, and the light sent upon both cells depends upon the thickness of the film, but cell No. 2 does not receive the light directly. For this purpose an electromagnetic shutter and a second beam from a lamp are used to throw light on cell No. 2. The

shutter receives current from the circuit of cell No. 1. In this way the effect on cell No. 2 is somewhat the same as if it had been lighted directly from the image. The combined current from both cells is now sent into the main line, as will be explained below, and the result is that such current shows but a small amount of lag with reference to the moment of changing the light upon the selenium cells and this practically overcomes the inertia of the cells when in combination, although each of the cells is unchanged and possesses the usual amount of inertia. The method of compensating can only be explained clearly by the use of curves in order to show the resulting effect. The main points as to the compensating method will accordingly be brought out in the theoretical account which follows.

Each of the instruments, transmitter and receiver (Fig. 3 and Fig. 4), is operated by a synchronous motor which will be observed in the engravings. To the motor shaft is connected the mechanism which is used for operating the cylinder in each case. The gearing which drives the cylinder shaft is arranged so that it can be varied by shifting a lever so as to give the normal speed or a slower speed. Usually the normal speed is employed, which gives the transmission of the image in about twelve minutes. Each of the synchronous motors is operated from a local storage battery by direct current. The armature of the motor carries also a ring collector at the other end, and from it can be taken alternating current. Such current is used for operating the frequency indicator. This latter instrument is shown in its essential parts in Fig. 5. A main electromagnet carries the coil W, and the laminated pole-pieces P P'. Attached to the pole-piece P are three tongues of spring steel, A, B, C, which are separated from the second pole-piece by an interval. The tongues are made to vibrate on the passage of alternating current, provided they are tuned so that their normal vibration period corresponds to the frequency of the current. In practice the three tongues are tuned so as to vibrate at 99, 100 and 101 periods, respectively. The upturned ends of the tongues are made to face a dial plate with the corresponding numbers engraved upon it, as will be seen on the right. When the frequency is at ninety-nine cycles, only the first tongue will vibrate. For 100 cycles the second tongue vibrates, etc. For ninety-nine and one-quarter cycles No. 1 vibrates in a smaller amplitude and No. 2 in a still smaller one; at ninety-nine and one-half Nos. 1 and 2 vibrate at a reduced and an equal amplitude. In this way the speed of the motor can be adjusted at each station so as to correspond. As usual in running synchronous motors the motor of station No. 1 (transmitter) is run somewhat slower than motor No. 2. When the cylinder shaft of No. 2 has completed its revolution, it thus arrives at this point somewhat before No. 1, and it is stopped automatically by a pawl. As soon as No. 1 comes to the same point, a current is sent into the line which operates the release of No. 2 by means of an electromagnet. Therefore both shafts start together for the succeeding revolution, and so on. Motor No. 1 is set by the synchronizer at say ninety-nine, while the second operator sets his motor at 101. The stop in the revolution of No. 2 is exceedingly short and does not affect the transmission. At this time a battery current is sent over the line and it is received in a sensitive relay which operates the electromagnet of the releasing device. At the same time the current

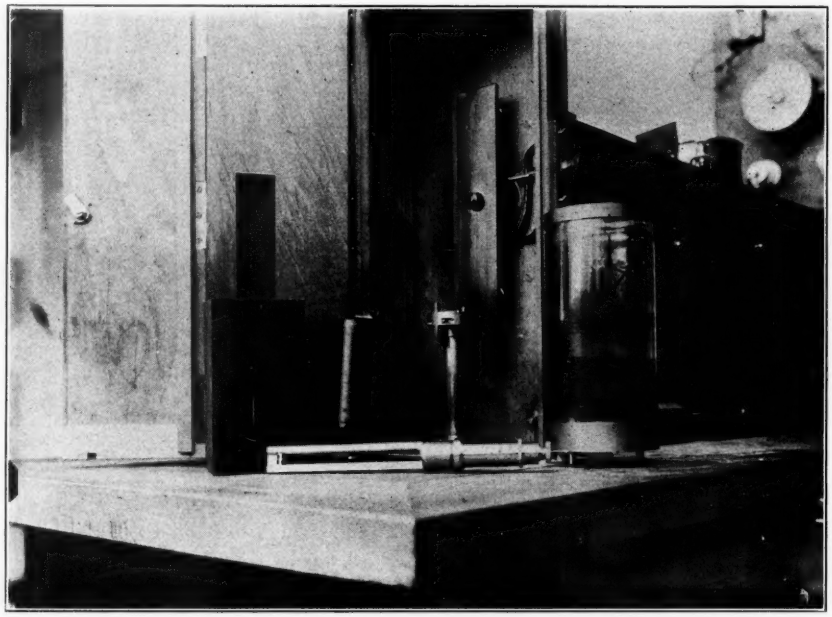


FIG. 3.—ONE END OF THE RECEIVER, SHOWING TRANSMITTER CYLINDER, MOTOR SHAFT, CYLINDER, ELECTROMAGNETIC SHUTTER AND DARK BOX.

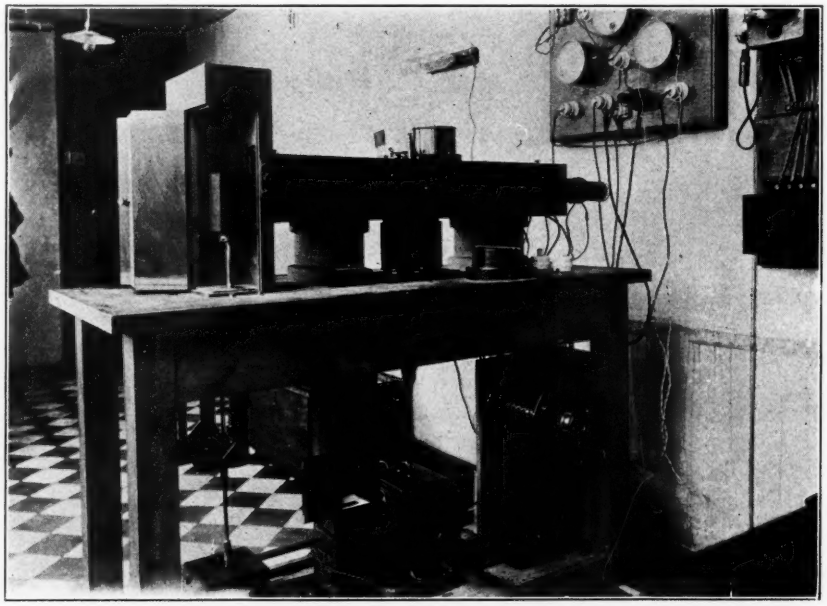


FIG. 4.—RECEIVER WITH DARK BOX IN PLACE. THE VERTICAL COLUMN IS SEEN BELOW, WITH THE COMPENSATING CELL.

from the selenium upon the line is broken automatically for an instant and the receiving electromagnetic shutter is likewise cut out.

The compensating method which was devised by Dr. Korn is of considerable interest, seeing that it is one of the main factors in the success of the present apparatus, owing to the fact that it over-

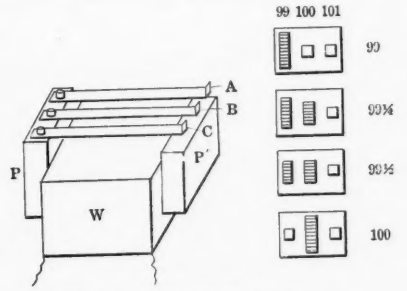
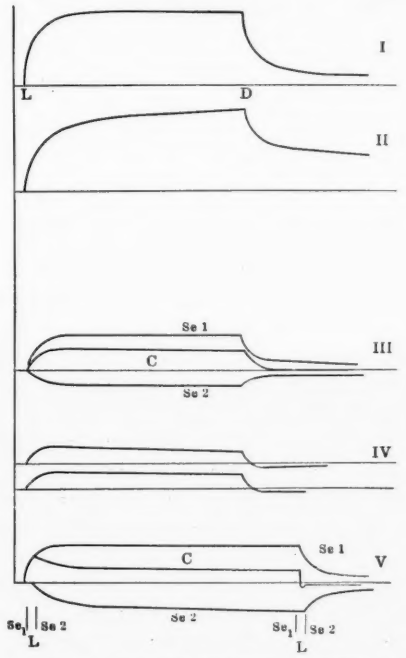


FIG. 5.—FREQUENCY INDICATOR.

comes the inertia of the selenium cell to a great extent. The result is that the image at the receiving end is much clearer, and at the same time the speed of sending the image can be reduced within a reasonable time, seeing that the



CHARACTERISTIC SELENIUM CURVES.

impulses of current in the cell can be made in a more rapid succession than could be done were the cell to have the usual amount of inertia.

Curves I and II[1] show the inertia of selenium cells when lighted and then darkened. When lighted (at L) the current rises, but not instantly. When the light is cut off (at D) the current value falls somewhat rapidly at first and then very slowly. In order to secure an abrupt rise and fall of the curve Dr. Korn employs two selenium cells which are of a different character as regards their physical properties and at the same time can be differently lighted if desired. By con-

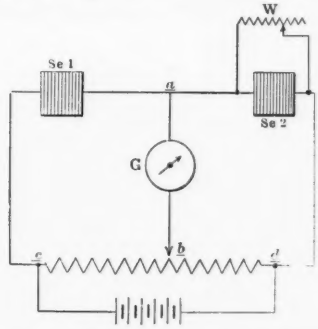


FIG. 6.—CONNECTIONS OF SELENIUM COMPENSATOR.

necting these two cells in opposition in a circuit on the Wheatstone bridge principle he is able to overcome the inertia to a great extent. The connection must be such that the differential current from the combination of the cells is greater than zero when the cells are lighted, and must be zero when in the dark. Referring to Fig. 6, he connects the cells Se^1 and Se^2 in a Wheatstone bridge circuit with the galvanometer G and battery. The bridge is balanced so that in the dark there is no current in the galvanometer circuit *a b*. Taking two cells having a different physical character, it is found that upon lighting them the resistances do not change equally, so that the bridge, balanced in the dark, will be unbalanced when the cells are both lighted at once, and a current will flow in *a b*. Such current will be stronger as the lighting is higher, within certain limits, and it is the difference of the currents which flow in the bridge arms Se^1 and Se^2; it also depends upon the difference of potential in *bc* and *bd* which form the other arms of the bridge. By displacing the contact arm at *b* we can find the best point for the compensation by experiment, and when this is found we proceed to balance the bridge (when the cells are in the dark) by means of the extra resistance W, which is connected across the cell No. 2. As this somewhat alters the first compensation adjustment, we make another adjustment at the other resistance. The result of this combination is shown in curve III, using the oscillograph to take the curves in the different arms of the bridge. In the curves marked Se^1 and Se^2 are shown the usual curves of current rise and fall for each of the two selenium cells taken separately. Here the inertia is large, especially at the drop of the curve. However, the differential current in the galvanometer shown at C is of a different character. The curve rises somewhat more rapidly, but at the drop the fall is much more rapid than usual, and the current value reaches zero very quickly. This effect can be further increased by the use of an over-compensa-

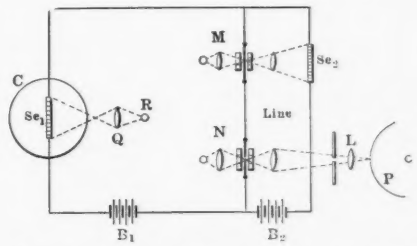


FIG. 7.—ANOTHER MEANS OF SECURING THE COMPENSATING EFFECT.

tion, so that the curve takes the forms seen in curve IV. Here the current falls below the zero line and consequently the drop is more rapid than before. The current in the galvanometer circuit, which is the one used in practice on the line, should be as large as possible and we should make the best choice of the differences of potential in *ab* and *bc* to carry this out. At the same time the current can be increased by lighting the two cells differently but still at the same moment.

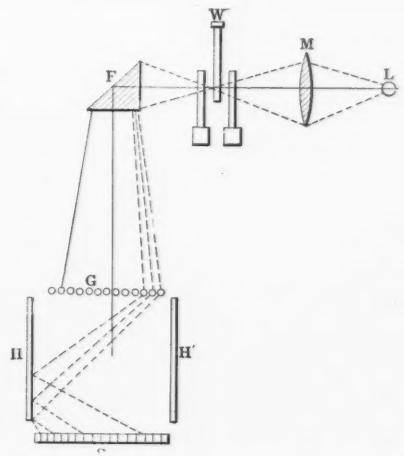


FIG. 8.—DETAIL OF PRISM AND DIFFUSING CHAMBER.

As mentioned above, the two cells must have different physical properties. Dr. Korn employs in general the form of cell which consists of a flat plate of insulating material having wrapped around it a number of turns of double platinum or other wire. Between the wires there is spread a layer of selenium in the usual way. Such a layer may be made thick, and in this case the resistance of the cell

[1] These curves were obtained by Dr. Glatzel of Berlin, to whom the accompanying description is due.

is less. But on the contrary the inertia is greater, as the effect of the light appears to take some time before reaching the under part of the selenium. For a thin layer of selenium the resistance is higher but the inertia is lower. Thus in curves I and II, the former shows the inertia of a 500,000-ohm cell, and the latter the inertia of a 70,000-ohm cell, and it is seen that the low-resistance cell has a much higher inertia. In carrying out the Wheatstone bridge combination just referred to we use a cell Se^1 which has a low inertia and high resistance, while Se^2 is a low-resistance and high-inertia cell.

By the use of the following methods Dr. Korn was able to secure a still better compensating effect. At the transmitting end (see Fig. 7) we have the cell Se^1 which is lighted through the photographic film by the lamp R and lens Q. Cell Se^2 (the compensating cell) is lighted by means of a second lamp and an electromagnetic shutter M, of the type which we have already described. At the receiving end is the electromagnetic shutter N, which causes light to fall upon the photographic film P. The three parts M, N and C are connected on the Wheatstone bridge principle upon the main line. When Se^1 is lighted the bridge balance is destroyed and a current is sent into M. This causes Se^2 to be lighted in turn, but nearly at the same time, the only difference lying in the very slight inertia of the electromagnetic shutter. Se^2 will thus be lighted somewhat later than Se^1. As seen in curve V, curves Se^1 and Se^2 are somewhat displaced and the result is the compensated curve C, which represents the current in the line. This curve has a quicker rise, and it also falls at a faster rate than the former compensated curves. Owing to this fact the instrument is affected by small variations in the lighting, that is in the image, which would be lost in the above method, so that the resulting photograph is finer in the details and therefore much superior.

In practice this is carried out by using the electromagnetic shutter of the receiver which is placed at the transmitting station. When sending the image it is out of action. In this case the reflecting prism F (Fig. 2) is shifted in the path of the beam so as to send it down into the chamber V. Here is placed the compensating cell S. Above it is a screen composed of a set of parallel glass rods G, for diffusing the light over the surface of the cell. This is shown in detail in Fig. 8, where L is the lamp, M the lens, F the prism and W the shutter. At G is a set of glass rods which act as cylindrical lenses. The two plane mirrors H H′ act in connection with the rods to give the diffusion of the light on the cell S.

THE DIRECT PRODUCTION OF COPPER TUBES, SHEETS AND WIRE.[1]

BY SHERARD O. COWPER-COLES.

The numerous processes involved in the production of suitable copper and its subsequent conversion into copper sheets, tubes and wire by a series of operations, such as rolling, drawing and annealing, would occupy too much time to be referred to even briefly; therefore the author has limited the paper to the direct production of copper tubes, sheets and wire by electrolysis from impure copper.

The methods described are all based on the work of Davy and the law of electrolysis established by Faraday in 1833, namely, that when a current of electricity is passed through a solution containing metallic salts and two or more electrodes, one of which is soluble in the solution, a known quantity of metal is transferred from one electrode to the other for a given quantity of electric current; that is to say, if the soluble electrode (the anode) is connected to the positive pole, and assuming the metal and the electrolyte employed to be pure, a weight of metal will be deposited upon the cathode connected to the negative pole, corresponding to the amount dissolved from the anode. If the anode is of impure metal many difficulties are introduced, and if the current is increased to a sufficient density to enable the metal to be deposited at such a rate as will give commercial results, other serious difficulties arise. Electrometallurgists have been working for thirty years or more devising methods to overcome the difficulties experienced in applying Faraday's law to the commercial production of copper tubes, sheets and wire from comparatively impure copper having the physical properties of wrought copper, when deposited at a sufficiently rapid rate.

The refining of copper by electrolysis has now assumed vast proportions, and the annual output of electrolytic copper in the year 1907 has been estimated at 400,000 tons, equal to fifty-six per cent of the world's production, and the capital sunk in the industry at about $75,000,000. The whole of the copper thus produced is in the form of rough slabs or cathode plates which have to be smelted and worked to the desired forms.

Electrometallurgists have been striving for many years to devise a process which does away with the smelting of copper after it has been electrolytically refined, and to electrodeposit copper after the refining operation in such a form that it can be placed direct on the market as finished sheets, tubes and wire.

[1] Abstract of a paper read at the Bristol meeting of the Institution of Mechanical Engineers, July.

WILDE'S PROCESS.

It was observed shortly after Elkington practically applied Faraday's law to the refining of copper in the year 1865, that the electric current density, or the rate at which the copper is deposited, could be considerably increased by circulating the electrolyte or moving the electrodes. It was soon found that circulating the electrolyte alone was unsatisfactory, and that the best results could be obtained with a vertical mandrel revolved in the electrolyte. Wilde was one of the first to use a cylindrical cathode, his object being to deposit copper on iron rollers suitable for textile printing purposes, for which he took out a patent in the year 1875. The anodes consisted of copper cylindrical tubes, and the iron cylinder to be coated with copper (the cathode) was placed in the centre of the cylindrical vat and caused to rotate on its axis. Such an arrangement, in conjunction with a circulating propeller placed in the electrolyte, insured an even distribution of copper over the whole surface uniformly along the length of the roller by means of the motion imparted to the solution, and the equal density thus maintained. The current density was low, considerably under twenty amperes per square foot.

ELMORE'S PROCESS.

The next development of importance was the Elmore process, which consists of using horizontal mandrels on which copper sheets or tubes are deposited, while agate burnishers travel continuously over the copper, so as to consolidate it, and at the same time prevent the growth of copper trees or nodules. Even with the use of a burnisher the current density could not be increased beyond thirty amperes per square foot, and the mechanical difficulties introduced by the burnisher are considerable. Large works were erected to operate this process near Leeds and on the Continent, and are principally engaged in the production of large tubes and cylinders for special purposes.

DUMOULIN'S PROCESS.

Dumoulin introduced, at a later date, a process for burnishing copper during deposition with sheepskin as a substitute for agate, and claimed that the process had also the advantage of insulating any projections that might be formed on the deposited metal, the sheepskin impregnator coating all projecting parts with a film of animal fat, thus preventing further deposition until the surrounding depres-

sions are raised to the common level. It was also claimed for this process that a current density of from thirty to forty amperes per square foot of cathode surface could be employed at a voltage of about 1.6 per vat. This process was tried on a large scale in England but was soon abandoned.

OTHER PROCESSES.

Attempts have been made at various times to further increase the rate of deposit by Swan, Elmore, Thofehrn, Graham, Poore and others, by impinging jets of the electrolyte against the cathode surface. The quality of the copper is liable to vary in density if impinging jets alone are employed; it is therefore necessary to move the cathode, otherwise the copper is deposited in the form of annular rings of varying density and smoothness.

The author, when carrying out some experiments on the production of copper tubes and sheets by electrodeposition on rotating cathodes, observed that when the speed was greatly increased entirely new results were obtained, and that a current density of 200 amperes or more per square foot could be employed, the copper remaining smooth and having a tensile strength equal to the best rolled or drawn copper, and in some cases a tensile strength some fifty per cent higher than that obtained by the ordinary process of casting and rolling, the tensile strength increasing with the rate of rotation of the mandrel. The result of revolving a mandrel at a comparatively high speed is that every molecule, as it is deposited, is burnished or rubbed down so as to produce a tough fibrous copper, the usual order of things being reversed, the present practice being to put the mechanical work into a mass of copper by rolling or drawing instead of treating each molecule separately.

CENTRIFUGAL PROCESS.

This observation led to further experiments, which resulted in evolving the process now known as the centrifugal copper process for the manufacture of sheets, tubes and wire, which will now be described in detail, together with the results obtained.

After a long series of experiments had been made to determine the best composition for the electrolyte and the most economical current density to employ, the critical speed was accurately determined by means of revolving cathodes in the form of cones. By observing the point at which the copper remains smooth, and by measuring the circumference of the cone at that point and multiplying it by the number of rotations per minute, the critical speed is readily determined; 200 amperes per square foot is found to be the most economical current density, although a current density up to 500 amperes per square foot can be employed by increasing the rate of rotation, but the increased cost due to increased voltage renders such a current impracticable for ordinary commercial work.

One of the chief difficulties inherent in any electrolytic or wet process for the production of copper tubes and sheets is having any working parts, such as bearings, in an acid copper sulphate solution, and this was one of the first troubles encountered when working the centrifugal process on a commercial scale. This difficulty was eventually overcome by constructing vats in the form of an annular ring, as shown in Fig. 1. It will be observed that by such an arrangement all

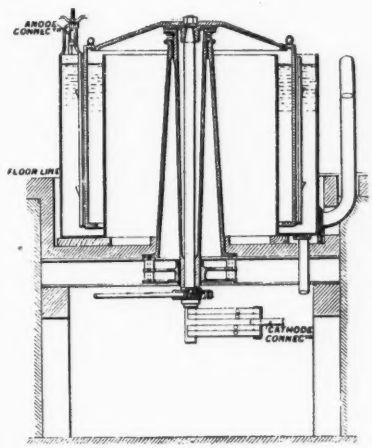


FIG. 1.—VAT USED FOR CENTRIFUGAL PROCESS.

working parts are outside the vat and do not come into contact with the electrolyte, so that the bearings can be lubricated in the ordinary way; only the actual face of the mandrel on which the copper is to be deposited is immersed in the electrolyte. The cathode consists of a steel or cast-iron cylinder closed at one end, to which is attached, on the inside, a steel rod projecting below the edge of the mandrel to guide it into position; the cylinder can be five or six feet in diameter or even larger so as to produce a copper sheet of say twenty feet long by four or five feet broad. Anodes composed of crude copper are placed around the mandrel with intervening spaces and are fed forward by suitable mechanical means as the copper dissolves away so as to keep the voltage constant.

One great advantage of the centrifugal process is that a very low voltage is required even when employing a very high current density; for instance, only 0.8 of a volt is required at the terminals of the vat when working at a current density of 200 amperes per square foot of cathode surface. The effect of revolving the cathode is fivefold: Firstly, it keeps the electrolyte agitated, so that there is always a fresh supply of copper ions in proximity to the cathode; secondly, each molecule of copper as it is deposited on the cathode is burnished or rubbed down by means of the skin friction between the revolving cathode and the electrolyte; thirdly, the rotation prevents any foreign matter that may be in suspension in the electrolyte settling on the cathode and becoming entangled by further copper being deposited around or over it; fourthly, it brushes away any air-bubbles on the cathode, which are the cause of nodules forming; and fifthly, the rotation of the cathode insures the thickness of copper being uniform even when a mandrel of say eight feet in length is employed.

The method of making tubes by the centrifugal process is as follows: A mandrel somewhat smaller than the finished internal diameter of the tube is prepared by coating it with an adhesive coating of copper by first depositing copper upon the surface from an alkaline solution and then thickening it up in an acid solution, the surface being highly burnished and treated chemically to insure the easy removal of the deposited tube. The mandrel thus prepared is then placed in a vat as shown in Fig. 1, according to the diameter of the tube and its length. When the desired thickness has been obtained the mandrel is removed and placed in a horizontal or vertical lathe, and a round-faced roller run over the surface so as slightly to expand the deposited copper, which can then be readily drawn off.

Copper sheets are prepared in a similar manner, the only difference being that the mandrels are of much larger diameter, and a narrow insulating strip is fitted down one side so that the sheet can be easily removed by inserting a tool under one of the edges of the deposited copper. It is no more costly by the centrifugal process to make thin sheets than thick ones; copper foil can be made like the samples exhibited in five minutes direct from crude copper.

Copper tubes produced by this process without any drawing have given a maximum stress of seventeen tons, and tubes after drawing have withstood a pressure

of 3,000 pounds per square inch without showing any signs of distress.

Sheets made without any rolling have given a maximum stress of twenty-eight to thirty tons and more per square inch according to the peripheral speed at which the mandrels were revolved.

The formation of copper trees and nodules was another difficulty that had to be overcome, but which has been reduced to a minimum in the centrifugal process, for the reason that impurities held in suspension in the electrolyte have no opportunity of settling on the cathode, and all gas bubbles are swept from the surface on which the copper is being deposited.

The percentage of free acid employed in the centrifugal process is high, amounting to twelve or thirteen per cent. The electrolyte, the usual composition of which is 12.5 per cent of copper sulphate and thirteen per cent of sulphuric acid at a temperature of forty degrees centigrade, is kept in the cupric state and the impurities in suspension separated by means of a centrifugal filter provided with arc lights and an atomizer for breaking the solution up into a fine spray, as shown in Fig. 2 and Fig. 3, respectively. It has been found that by subjecting the solution to a strong light the impurities are more easily precipitated, and the solution is kept in the cupric state.

The production of copper wire by electrolytic means is a more difficult problem than the production of copper tubes and sheets. Various processes have been suggested and tried from time to time, such as the electrodeposition of copper on thin wire, until it has obtained a considerable thickness, and then drawing the thickened wire down to a comparatively fine wire. Swan and Saunders have both experimented with such processes, but so far they have not been worked commercially.

Elmore's process consists of producing copper tubes by his burnishing process, cutting them into long spirals and then drawing them into wire.

Other experimenters have tried placing an insulated spiral strip on a cylindrical mandrel so as to produce long copper spirals, but such an arrangement only allows of a very low current density being employed, on account of the nodules which form on the edges of the strip, even at very low current densities, rendering the strip unsuitable for drawing down into wire.

Copper wire is made by the centrifugal process in the following manner: A mandrel similar to that used for making copper sheets is employed, around which a spiral scratch is made, the pitch being determined by the size of wire required.

The effect of the spiral scratch (which need only be very light but must be angular) is to cause the crystalline structure of the copper to form a cleavage plane, as shown in Fig. 4. It will be observed that the copper divides exactly at the apex of the scratch, that is, the copper deposited in the scratch is equally divided and forms a small V-shaped fin on two sides of the copper strip. If the scratch is not angular, but rounded at the base, the copper will not divide, as the crystals are radial. After the desired thickness has been obtained, approximating the pitch of the spiral scratch, the mandrel is removed from the depositing cell and placed in a vertical position on a lathe and the copper strip is unwound at an angle of about forty-five degrees to the face of the mandrel. During the process of unwinding the small fin or burr is removed by passing the wire through a suitable die and then through a wire-drawing machine provided with three or more draw-plates to reduce the strip to the desired diameter. By employing a mandrel of six or seven feet in diameter, lengths of wire four or five miles long can be made in one operation.

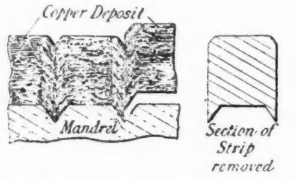
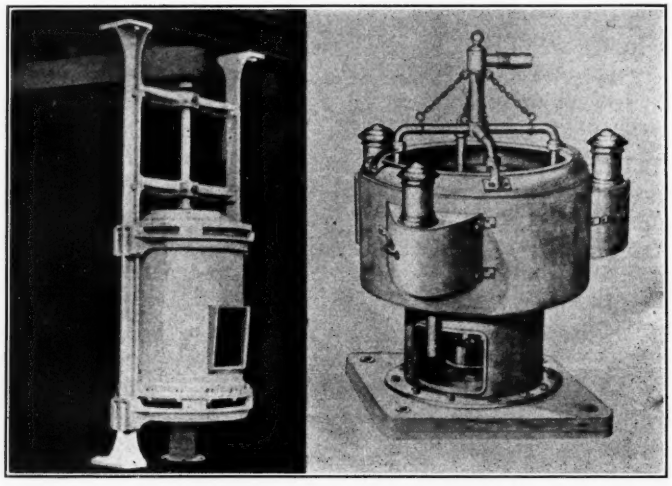


FIG. 4.—DIAGRAM SHOWING METHOD OF FORMING WEAK LINE OF CLEAVAGE DUE TO CRYSTALLINE STRUCTURE.

CONCLUSION.

The advantages of an electrolytic process as compared to a smelting process are many and the day is not far distant when copper will no doubt be leached direct from the ore and electrolyzed with insoluble anodes, to produce finished copper sheets and tubes in one operation direct from the ore without the intermediate process of smelting and refining.



FIGS. 2 AND 3.—ATOMIZER AND FILTER.

The centrifugal process is a step in this direction, as it is capable of depositing copper from its solutions by using insoluble anodes in the form of finished tubes or sheets in one operation. The centrifugal process is at least ten times faster than any existing electrolytic process, and a high current density can be employed without deteriorating the quality of the copper. There is no risk of lamination, as no burnishers are employed. The plant is simple and free from mechanical complications, and the amount of copper locked up for a given output is small compared to other processes.

APPENDIX.

The following is a typical analysis of the copper produced by the centrifugal process:

Iron	0.0189
Arsenic	0.0015
Lead	0.0013
Antimony	0.0010
Bismuth	0.0008
Silver	absent
Nickel	absent
Sulphur	absent
Copper (by difference)	99.9765
	100.0000

Under favorable conditions the theoretical weight of copper is obtained, and the table (I) gives the weights and thicknesses of copper deposited in an hour at the current densities usually employed.

The capital expenditure of a plant for the centrifugal process both for the manufacture of sheets, tubes and wires, compares very favorably with an up-to-date

rolling mill and wire-drawing plant. The cost of such a plant, with buildings, is about $400,000 for an output of 100 tons per week or 5,000 tons per year. The following is an estimate of the cost of a plant for the centrifugal process capable of dealing with 10,000 tons of tubes, sheets and wire per annum:

ESTIMATED COST OF PLANT FOR PRODUCING 10,000 TONS OF TUBES, SHEETS AND WIRE PER ANNUM BY THE CENTRIFUGAL PROCESS.

Cost of ninety-five vats and accessories	$320,000
Machinery for finishing tubes, sheets and wire	25,000
Cranes and lifting gear	7,500
Building	75,000
Plant for mandrel-making	10,000
Machinery for fitting shop	7,500
Pumps, atomizers, filter tanks	25,000
Driving machinery for vats	25,000
Conductors and electrolyte	25,000
	$520,000
Floating capital for copper	150,000
	$670,000

TABLE I.

TABLE GIVING THE WEIGHT AND THICKNESS OF COPPER DEPOSITED PER HOUR AT VARIOUS DENSITIES WITH METRICAL EQUIVALENTS.

Current Density in Amperes per Square Foot.	Weight of Copper Deposited per Hour per Square Foot. Pound.	Thickness of Copper per Hour. Inch.
150	0.3893	0.00872
160	0.4153	0.00930
170	0.4413	0.00988
180	0.4672	0.01046
190	0.4932	0.01105
200	0.5191	0.01163
210	0.5451	0.01221
220	0.5710	0.01279
230	0.5970	0.01337
240	0.6230	0.01395
250	0.6489	0.01453

ESTIMATE OF COST PER TON OF PRODUCING COPPER TUBES, SHEETS AND WIRE BY THE CENTRIFUGAL PROCESS DIRECT FROM CRUDE COPPER.

Power per ton (2,240 pounds), 1,015 kilowatt-hours at 0.55 cents per kilowatt-hour	$5.58
Wages at 16 cents per hour, 18½ hours	2.96
Management	1.25
Interest on copper lock-up	.25
Depreciation on plant and building	2.50
Heating electrolyte	.25
Finishing and gauging	1.25
Cost per ton	$14.04

These figures represent the actual working cost on which there would be a further reduction of the precious metals recovered and if $7.50 be deducted from the above cost, which may be taken as an average difference between Chili-bar and electrolytic copper, the cost per ton is reduced to $6.62.

Chicago Street Railway Accidents.

The Chicago City Railway Company announces that the number of fatal accidents for the first half of 1908 was the lowest on record, there being only one killed in every 4,172,727 passengers carried. This is stated to be a direct result of the use of the new pay-as-you-enter cars.

Electric Smelting by the Lash Process.

In the summary report of the mines branch of the Canadian Department of Mines for the 1907-1908, recently published, some attention, says the *Iron Trade Review,* is given to the solution of the problem of the direct production of steel from the ore, in connection with which technical difficulties have been encountered. It is thought that these may be overcome by the application of the Lash steel process in an electric furnace, and the Canadian Lash Steel Process Company, of Niagara Falls, furnishes a description of its working. Successful experiments with this process in the case of the open-hearth furnace on a commercial scale indicate its possibilities with regard to electric smelting. In this process finely divided ore is mixed with carbon, a certain quantity of finely divided carboniferous iron, such as cast-iron borings, or granulated pig iron, sawdust and fluxes suitable for the iron ore under treatment. The working of the process can best be explained by comparison with the open-hearth "ore process," which consists in forming a bath of molten pig iron and then adding thereto a sufficient amount of ore (iron oxide) to reduce the carbon content of the metal to the desired amount. The oxygen of the ore, combining with a certain amount of the carbon in the pig iron, forms carbon monoxide gas and sets free the iron of the ore to mix with the bath of molten metal. Thus a mixture of approximately seventy-five per cent pig iron and twenty-five per cent ore can be worked up. But in the Lash process the proportions are very different, for a large proportion of ore can be used with a small percentage of carboniferous iron. A typical mixture has the following percentage composition:

	Per Cent.
Iron ore	54
Cast-iron borings or granulated pig iron	27
Sawdust	4
Limestone	4
Coal tar	3
Coke	8
	100

These constituents are finely divided and intimately mixed, and when heated to a high temperature the reactions that occur are similar to those found in the open-hearth furnace using the ore process. The cast-iron borings correspond to the molten bath of pig iron and react with the ore, but the latter being in large excess it is necessary to supply a certain amount of free carbon in the form of coke for the complete reduction of the ore. The great economy of the process lies in the substitution of a large amount of ore for pig or scrap iron. In using the Lash mixture in the open-hearth furnace it is necessary to have a bath of molten metal, as otherwise it would not be practicable to heat it to the reacting temperature without losing carbon in the mixture by combustion. If, however, the charge is put into an electric furnace, no difficulty of the kind is experienced, since the gas in an electric furnace is neutral, in contradistinction to the oxidizing atmosphere of an open-hearth furnace. Experiments using the Lash mixture have been made in the electric furnace on a small scale with successful results. It was found that the yield of metal amounted to ninety-eight per cent of the metallic content of the mixture. The average cost of the materials in Canada for the production of 100 tons of steel ingots in the regular open-hearth furnace is $20.79 per ton, and it is claimed that by using the Lash mixture in the electric furnace this can be reduced to $16.22 per ton, and that the technical difficulties which have been encountered in the production of steel directly from the ore by electricity will disappear. Different electric furnaces are being tested to ascertain the type most suitable for the application of the process.

Functional Organization for the Central District and Printing Telegraph Company of Pittsburg.

A new form of organization, similar to that being put into effect by the New England Telephone and Telegraph Company and other large Bell subsidiaries, has been adopted by the Central District and Printing Telegraph Company, of Pittsburg, Pa. The organization was effective September 1 in Allegheny County and will be extended to the balance of the company's territory at as early a date as practicable. M. C. Rorty has been made general superintendent, S. P. Grace general superintendent of plant, and F. O. Hale general superintendent of traffic.

The Pennsylvania Electric Association.

The first convention of the Pennsylvania Electric Association will be held at Eagles Mere, Sullivan County, Pa., September 8 and 9. Arrangements for the accommodation of those attending the convention have been made at the Forest Inn Hotel, Eagles Mere Park. The secretary of the association is E. L. Smith, of Towanda, Pa.

REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE

The Rose Recording Target.

A form of recording target which requires only three wires and yet reproduces the record of the shot at the point of fire, showing the point where the bullet hit within one-sixteenth of an inch, is described here. It is the invention of S. A. M. Rose, of Melbourne, Australia. By this instrument much time and possible misunderstanding and considerable expense may be avoided. In its simplest form the target is intended for showing the results of single shots, but it can be adapted to volley firing by the addition of a cable which takes the place of the three wires. The advantages of this target are its simplicity, as compared with other automatic recording targets; the fact that no more or less delicate mechanisms are subjected to the violent impacts of the bullets, and the actual targets can be preserved for record if desired or may be patched up for immediate use again. The target is printed on a roll of paper or cloth at regular intervals, and means are provided for exposing a new target by winding off the roll on to a drum. This traversing of the paper is effected by some means which gives absolute synchronism at the firing point with a smaller roll of paper, upon which the record is reproduced. As the target is rolled off it passes under a row of contact fingers, each finger of the set being connected to a point of a resistance in an electric circuit running to the recording station. When a hole in the target passes under these fingers certain ones fall through and make contact on a bar underneath. The position of the fingers determines the strength of the current which flows, and this current at the receiving recording station draws up the core of an electromagnet to a corresponding height, thus bringing a pencil or other marking device to the position on the record corresponding to the hole made by the bullet. Two guide marks are punched on the target and are marked on the record in their proper positions and enable a transparent gauge to be placed upon the record and show the exact locations of the shot. This target could be used for volley firing and would show correctly any number of shots at once if not more than one shot fell in line with the contact fingers at once. In that case the recording pencil could not record properly. To reproduce properly such a record it is necessary to run a wire from each contact finger to the recording device, where there is a magnet and stylus for each finger. When these styluses are drawn against a ribbed back they tear slits in the record showing exactly the location of holes in the original target. These tears can not be obliterated or imitated. With a target six feet square and contact fingers a sixteenth of an inch apart, 1,152 wires are required for Rose's apparatus, but since this cable is used intermittently only it could be used for a large number of targets. Other recording systems to give an equivalent record would require the square of this number of wires.—*Abstracted from the Electrical Engineer (London), July* 31.

The Tantalum Wave Detector.

A description is given here of a new electric-wave detector, devised by L. H. Walter, the idea being to make use of the indifference of tantalum to the atmosphere and to mercury and the spontaneous decohering property of mercury. This combination has been made practical by the introduction of the tantalum lamp, since before this tantalum was not procurable. The first experimental detector was made by passing two tantalum wires taken from an ordinary tantalum lamp through two capillary tubes of glass, allowing the wires to project about one-twentieth of an inch and their points just to touch the surface of a small pool of mercury. Trials of this detector gave good results and it was found that both the liquid dielectric and the insulating sheathing could be dispensed with. The actual device consists of a glass stem through which two platinum wires are sealed, similar to the arrangement used in incandescent lamps. One of these wires is longer than the other and is allowed to project down into the mercury. The shorter one is formed into a clip into which a short piece of tantalum wire is inserted. The whole is enclosed in a small glass bulb into which enough mercury is poured to make contact with both wires. The bulb is then sealed up. It may be exhausted if thought desirable. With this arrangement connections are easily made by means of the platinum leading-in wires. The tantalum wire is about 0.05 millimetre in diameter and should have its lower end just immersed in the mercury. When thus constructed the device appears to be permanent and not to deteriorate and is not too fragile to transport. Detectors of this form have been tried in actual wireless work. They do not seem so sensitive as the electrolytic or magnetic detectors for very weak signals, but for slightly stronger signals they give sounds several times as strong as the electrolytic, which is itself more sensitive than the magnetic. With the second detector made, signals were obtained from a distance of seventy miles over sea without any attempt at tuning. These sounds were louder than those given by an electrolytic detector with the aid of a step-up oscillation transformer and careful tuning. One of the less satisfactory of a later model of this detector has given satisfactory signals at a distance of 450 miles from an ordinary ship installation of two kilowatts. By means of the resistance substitution method it has been found that in the receptive condition the resistance is only 1,200 or 1,800 ohms (the electrolytic is 30,000 or more), and this low resistance should be beneficial for tuning. When oscillations are acting the resistance drops to anything from 250 ohms for strong signals to perhaps seventy ohms for very strong signals. The ratio of the current when oscillations are acting to that in the normal condition is from 3 to 1 to 8 to 1, and may be as much as 30 to 1. On account of this characteristic the inventor thinks the tantalum detector is particularly adapted to wireless telephony since here the use of microscopically weak signals is out of the question, and it is here that the superiority of this detector for moderately strong signals will be useful. The form of detector described above, while suitable for fixed stations, does not work well when it is subjected to shaking or mechanical shocks, as experienced on shipboard. To meet this requirement a form in which the mercury is rendered immobile has been developed. The platinum wire with the clip

is sealed into a minute glass bulb, to which a capillary tube is attached. The tantalum wire passes through this tube. The whole is exhausted and sealed. Then the tube is carefully heated until it collapses on the tantalum wire. The tube is then ground off so as to present the end of the tantalum wire. This tube is slipped through an ivory plug, which is in turn inserted in a second glass tube about five-sixteenths of an inch in diameter. A little mercury is poured into this tube, so as to be in contact with the exposed end of the tantalum wire, and the tube is closed with a second ivory plug through which a platinum wire passes. The outer tube is then placed in an ebonite tube for protection and is mounted so as to be rotatable about a horizontal axis. The most sensitive position is with the tantalum wire at the top. The outer glass tube should be about five-thirty-seconds of an inch in diameter. A larger tube would be more sensitive and constant but not free from the effects of vibration. A smaller tube gives a less sensitive and more variable detector. Although tantalum, the first metal tried, gave such good results, a number of others were experimented with, such as iron, nickel, tungsten and certain alloys, but all of these gave perfect contacts and were therefore not suitable. No effect was obtained with vanadium, molybdenum, cobalt, manganese, tellurium, zirconium, ferro-silicon, ferro-manganese, ferro-nickel, antimony or bismuth. But a fairly sensitive and moderately loud detector can be made, using pure tantalum on several solid metals. Oxidized iron seems to be the best, but an equally sensitive, though not so loud, instrument is given with tantalum on tellurium. None of these arrangements at all compares with the tantalum-mercury instrument. — *Abstracted from Electrical Engineering (London), July 3.*

On Earth Currents and Magnetic Variation.

The relation between earth currents and magnetic variations is very far from being known thoroughly. The main question, according to Dr. L. Steiner in this article, is whether the magnetic variations are entirely, or at least partly, due to the electromagnetic action of earth currents, or whether they are in turn induced by the magnetic variations. It has not yet been satisfactorily answered. Many investigators are inclined to accept the former view, relying mainly upon observations made at times of magnetic storms. The few data at our disposal concerning the daily variations on calm days have not yet settled the question. The elaborate investigations dealing with this subject—the well-known investigations of Professor Weinstein—advanced the problem considerably, but they do not lead to final results. If the earth currents are the primary causes of the daily magnetic variations, then we should expect that the west-east components of the currents are connected with the north components of the magnetic variations, and the north-south components of the currents with the west-east components of the magnetic variation. The observations at Paris seem to confirm such a connection for the west-east currents, but the connection for the north-south currents is not so evident. Schuster, von Bezold, and Fritsche have shown that the daily variation of terrestrial magnetism is to be ascribed to two causes, one outside, the other inside the earth. The numerical separation of the two, as far as the data permitted, has been done by Fritsche. A tabulation of his results, which is given, shows an obvious parallelism between the east-west earth current and the north-south magnetic variation, but no connection between the north-south current and the east-west magnetic variation. Deriving, however, the differential coefficients for the latter variation, a direct variation apparently results. If we imagine the earth current contained between two plates in the earth is closed somehow in the interior of the earth, then an increase of the magnetic force to the west induces—in conformity with Maxwell's rule—an earth current in the north-south direction, and a decrease of the force to the west, an earth current in the opposite direction. The table of coefficients shows these characteristics. The extreme values and the changes of sign occur in the differential coefficients at the same time, or a little earlier, than for the earth currents, which seems favorable to the supposition that these currents are induced by the changes in the earth's magnetism. The agreement is not so close for winter as for summer, which is not surprising when all the complex factors entering into the phenomena are considered. By tabulating Fritsche's and Weinstein's results for the Berlin-Dresden line and the Berlin-Thorn line a loose agreement between the earth currents and the north-south magnetic variation only is found for the latter line, while the former shows a remarkable agreement between the earth currents and the differential coefficients of magnetic variation. This seems to prove that a part at least of the daily magnetic variations is related to the earth currents in such a way that the north-south magnetic variations are partly electromagntic actions of the east-west currents and the north-south earth currents are partly induced currents caused by the variations of the east-west magnetic variation. If these remarkable connections be real then the relation of the earth currents and the magnetic variations is more complicated than would at first be supposed, and the physical explanation of it seems to present great difficulties. Why should the east and west currents act as primary causes and the north-south currents behave like currents induced by the east-west magnetic variation? The sun may have something to do with this, as the temperature gradient caused by its daily action is greatest in the east-west direction, and may thus give rise to earth currents in the same direction. These currents may be looked upon as primary currents. The unsymmetrical distribution of the stream lines in the east-west direction allows us to expect a magnetic force in the same direction, and the variation of this component will induce currents in the north-south direction. This explanation, however, is easily attacked, and the above apparent connections still await explanation. Schmidt has put forward the hypothesis that the earth currents are due to induction in the wires. Weinstein holds the contrary view. It seems possible that, so far as the inner agencies of magnetic force are considered, there may be a difference between the north-south and the east-west currents with regard to their origin.—*Abstracted from Terrestrial Magnetism and Atmospheric Electricity (Baltimore), June.*

A New Smokeless Fuel.

A patent fuel has recently been brought out by a French inventor, designated as "charbonnette." This fuel, it is stated, can be produced for about two-thirds the cost of coal. It lights easily and, rapidly becoming incandescent, no smoke is emitted, while at the same time it gives out intense heat and leaves very little ash. It is manufactured in briquettes, and its main features are cleanliness in handling and the absence of odor. It is understood that the preliminary tests have been so satisfactory that a manufactory is to be erected.

INDUSTRIAL SECTION

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS

SUCTION GAS PRODUCER POWER.

AMERICAN PRODUCERS FOR AMERICAN COALS AND LIGNITES.

BY L. P. TOLMAN.

The early history of producer gas dates as far back as the year 1509, at about which time the "Fulen Heitzen" first became known, and were described by H. Brunschwyk in his book "Ars Distillandi de Compositis," or "The Art of Distilling Compounds," which was published in Strassburg, Germany.

The first plant similar to those now in use was built by Emerson Dowson, who has the distinction of introducing, in England, in 1878, the first practical gas producer for power. This was of the "pressure" type. A small steam boiler was necessary, as well as a large gas holder.

Then followed the invention of Herr C. Wiegand, of Hanover, Germany, who in 1895 took out the first patent (No. 88,044, German) on the principle of the modern suction gas producer. The importance of this invention was not realized in Germany until some years later.

In France, during the same year, Benier built what is believed to be the first practical suction gas producer. This was a success as soon as the necessary changes had been made in the gas engine to adapt it to the "suction" system. It is surprising in this case, as with most other great inventions now in general use, that an apparatus so simple and easily understood was not developed long before.

About five years ago American manufacturers began to take a live interest in the success of European, and especially German, suction gas power plants.

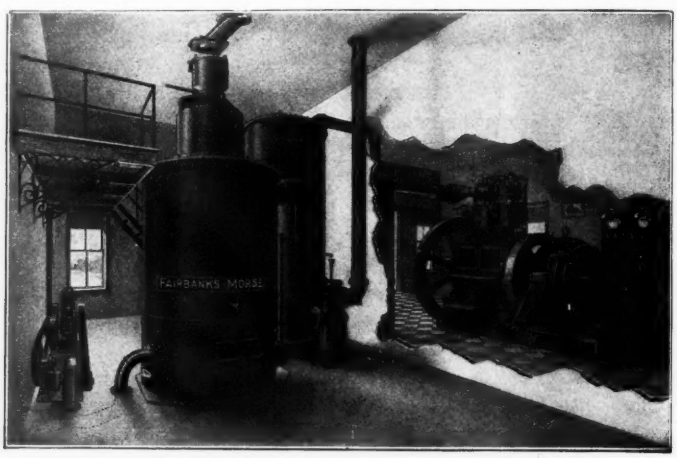


FIG. 1.—COMPLETE PRODUCER-GAS POWER PLANT, WITH ENGINE DIRECT-CONNECTED TO DYNAMO.

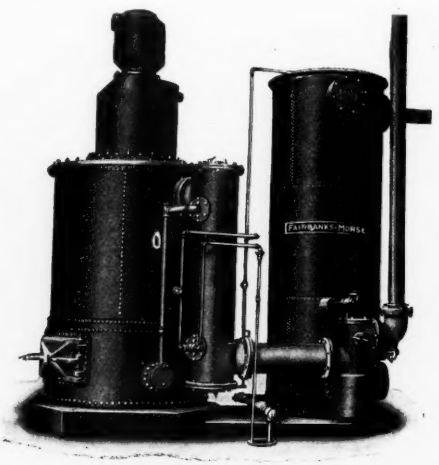


FIG. 2.—FAIRBANKS-MORSE SUCTION GAS PRODUCER.

Mr. Dowson's plants were successful and are still in regular service. Anthracite is the usual fuel.

The next substantial progressive step was taken when Dr. Ludwig Mond, in England, in 1889, developed the first successful soft-coal producer. This became a standard for sizes of 250 horse-power and larger but proved too elaborate and expensive for use in smaller sizes. With this plant a large gas holder is needed, also a steam boiler and an elaborate system of gas washers, purifiers and economizers.

American engineers visited Europe and in this way learned at first hand what was being done abroad. As early as the year 1904 it is estimated that there were over 10,000 suction gas power plants in Germany alone. They had come into general use and were found in the finest hotels, stores, factories, etc., for electric lighting and other power purposes. The actual users of the plants were enthusiastic over the results.

That producer-gas power is a pronounced success in the United States is evidenced by the large number of satisfactory installations already in operation on American coals. It is estimated that there are over 500 producer power plants in this country, having an aggregate of 150,000 horse-power. Of these, about eighty-five per cent are of the "suction" type and fifteen per cent of the "pressure" type. The suction plants average approximately 100 horse-power each while pressure plants are usually built in sizes larger than 1,000 horse-power.

This article deals with suction gas power plants in single units of 200 horse-power, or smaller, and complete plants made up of a number of such units, 1,000 horse-power or larger. This range of sizes covers the requirements of the great majority of power users.

Fig. 1 illustrates a suction gas producer power plant. The apparatus is simple, reliable and economical. With this plant eighteen per cent of the total energy of the fuel is converted into useful work. (Varies according to conditions from fifteen to twenty-one and one-half per cent.) This means that a suction gas producer plant uses from one-half to one-fourth as much coal for a given amount of power as a steam plant.

A 150-horse-power suction producer plant, running two-thirds load, 3,100 hours per year, uses approximately one and one-half pounds of coal per brake horse-power per hour. (Tests have been made showing a consumption of less than

one and one-quarter pounds at two-thirds load and less than one pound at full load.) With anthracite at $5 per ton the fuel alone costs $1,162.50 per year. Furthermore, the cost of attendance can be reduced materially with a producer plant, as the operator can spend part of his time in other useful work.

Much valuable information is given in the report of the United States Geological Survey concerning the fuel testing plant at the Louisiana Purchase Exposition, St. Louis, Mo. For three years the government experts conducted a series of tests on many samples of coal from mines all over the country. Briefly, the apparatus included a non-condensing Corliss engine steam plant with water-tube boiler and a pressure type producer with three-cylinder vertical gas engine.

From the summary of results obtained from a long series of tests, the fuel consumption in pressure type producer plant varied from 1.18 to 3.47 pounds per brake-horse-power per hour, the average being approximately one and three-quarters pounds. The average with the Corliss steam plant was found to be approximately four and one-half pounds, using similar fuels. With lignite the consumption in pressure producer plant was from 1.95 to 3.47 pounds, the average of five samples actually figuring 2.60 pounds. With Corliss steam plant using lignite the average consumption of "coal as fired" (not "dry coal") was approximately seven pounds.

Fig. 2 illustrates an exterior view and Fig. 3 a sectional view of a Fairbanks-Morse anthracite suction gas producer. All of the principal features are clearly shown. Coal is admitted to the producer through a hopper at the top. This has double closure, so that fuel can be introduced without at the same time admitting air. In the process of partial combustion which takes place producer gas is generated.

The hot gas passes through a vaporizer in which a small amount of steam is formed which, with a limited amount of air, passes under the grate of the producer. In the smaller sizes the vaporizer is at the top of the producer where it uses the waste heat from the escaping gas and where, at the same time, the water keeps the top from getting too hot. In the larger sizes the vaporizer is separate and connected to the producer by piping.

From the vaporizer the hot gas flows through the scrubber, which is merely a cylindrical-shaped tank filled with coke over which a spray of water is constantly sprinkled. The large contact surface of the coke effectually cleanses the gas of dust and impurities carried over from the producer, and also acts to cool the gas, which is essential in order to prepare it for use in the engine.

With certain fuels, especially when much tar is encountered, it is also necessary to add a sawdust purifier in order to abstract the last traces of tar from the gas. While not absolutely essential, yet it is always advisable to use a gas tank between the scrubber and the engine, in which a certain amount of gas is stored for ready use in the engine. This is especially desirable where the loads are variable.

In the care of the producer, the principal attention needed is to poke the fire every few hours, according to quality of the coal, in order to break up and remove clinkers, which would otherwise interfere with the making of sufficient gas. Poke holes are provided so that every part of the fire can be reached conveniently.

Anthracite in "buckwheat" or "pea" sizes, lignite, coke and charcoal are the fuels commonly used. In many sections these small sizes of anthracite can be bought cheaply in car lots. For example, in Chicago the car-load price of "buckwheat" anthracite is usually about $3.75 per ton. In some of the states west of Chicago the price varies from $5 to $7 per ton. At some points in southern

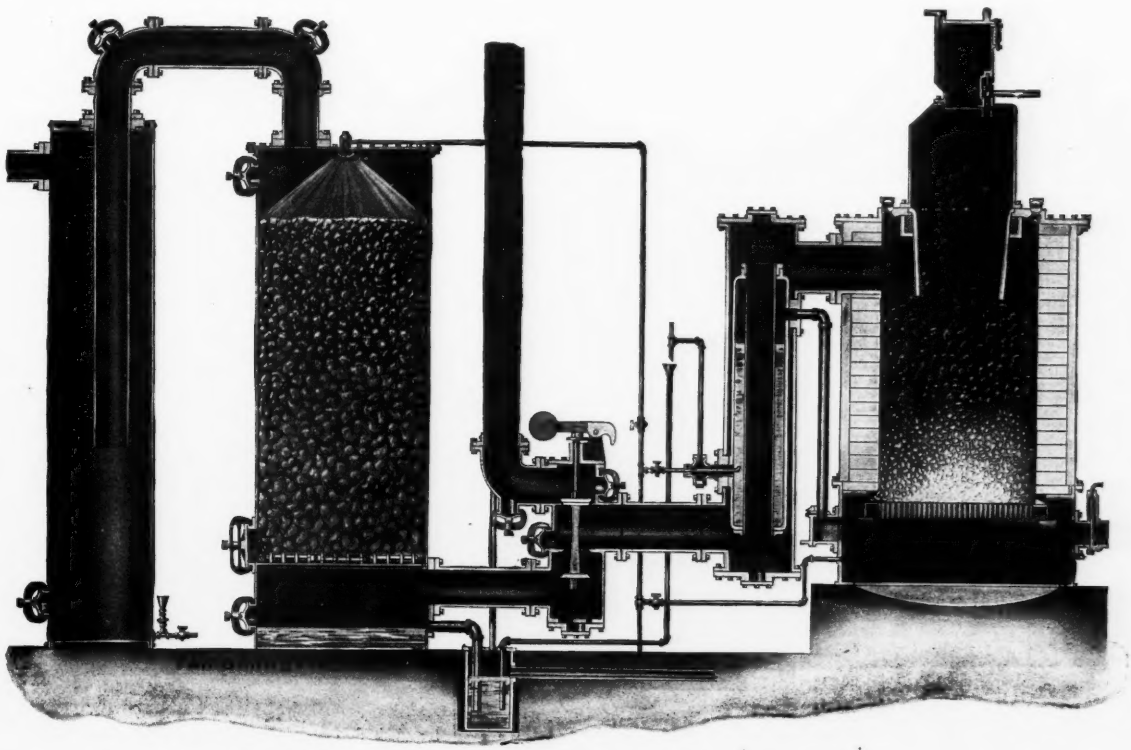


FIG. 3.—SECTIONAL VIEW OF FAIRBANKS-MORSE SUCTION GAS PRODUCER.

Canada these small sizes of Pennsylvania anthracite can be bought for from $3 to $4 per ton. In some of the eastern states, which are nearer the source of supply, the prices are even less.

The lignite producer offers a wonderfully cheap and reliable power in sections where this fuel is available. This can usually be had at a price of from $1 to $3 per ton. At Smithville, Tex., where a 150-horse-power lignite producer plant is installed, the cost is $1.70 per ton. Lignite is of little value for steaming purposes, mostly due to the large amount of moisture, but it makes a most excellent fuel for the producer and in some respects is easier to handle than anthracite.

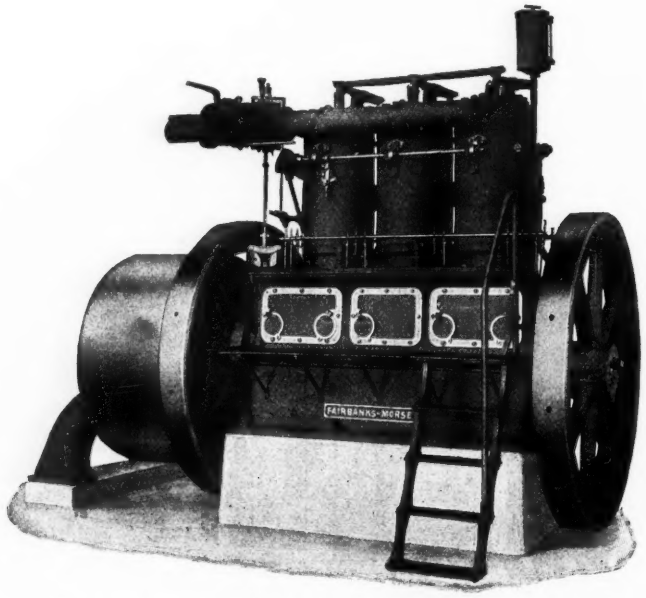


FIG. 4.—MULTI-CYLINDER VERTICAL PRODUCER GAS ENGINE.

Coke and charcoal are economical fuels in some sections and can be used separately or mixed with anthracite.

Producer gas engines of the vertical type are made in sizes of 200 horse-power and smaller. By combining several units plants of 800 to 1,000 horse-power or larger have been installed. Fig. 4 illustrates a thoroughly modern Fairbanks-Morse engine of this type. It may be of interest to engineers to note briefly a few of the carefully developed features in the design of these engines.

The present system of ignition is a great improvement over the methods formerly used. The make-and-break igniter is so constructed that it can be adjusted to spark as early or as late as desired, when the engine is running or at rest, by means of a convenient hand lever. A single lever controls the time of ignition for all cylinders. This is a feature of much importance, especially with producer gas, as it permits timing the ignition to give the greatest possible power and economy with any particular grade of gas and when the engine is running. In addition, there is an independent adjustment for each igniter which is operated by drop cam.

Igniters can be removed, inspected and cleaned without interfering with other working parts, and they are located most conveniently. As the successful operation of a gas engine depends largely upon the igniter the value of these features can not be emphasized too strongly.

Both valves are mechanically operated from a single cam shaft, which is located inside the crank case. This minimizes the amount of noise, and furthermore the two-to-one reduction of gearing includes a pinion which is made of alternate layers of steel and red fibre. These features insure a quiet running engine.

The simple fly-ball governor is of a most carefully designed pattern. This operates a balanced disc valve which is so constructed that there is no frictional contact or surface to become fouled by any impurities in the gas. This is especially important with engines operating on producer gas. The governor insures very close regulation, adapting the engine for electric lighting and other service requiring uniform movement.

Lubrication is effected by means of a single elevated oil reservoir which is provided with separate brass pipe with individual sight feed for each bearing. This is a most effective system of engine lubrication and has been adopted as the best to be had. The drip from the different bearings collects in the base of the engine, which is drained by means of a small pump. The oil is run through a filter and is then used over again.

Each engine is fitted with a hand-operated speed regulator, by means of which speed can be reduced when the engine is running.

One cylinder of each engine is fitted with automatic compressed-air starting gear. This can be thrown into or out of action by the movement of a single lever, and the engine is started automatically on compressed air.

From report on fifty-horse-power plant used in operating marble works in Tennessee, statement is made that they use only eighteen ordinary hods of buckwheat anthracite per day of nine hours at a total cost of $1.39 for the coal. At this plant they poke the fire once in the morning before starting and once at night after shutting down. Outside of this the plant requires very little attention.

One of the largest suction gas producer plants in the United States comprises six 150-horse-power engines and one 200-horse-power engine—1,100 horse-power in all—complete with suction gas producers, using anthracite as fuel. This plant is in Wisconsin and is operated twenty to twenty-four hours each day, excepting Sundays and holidays.

A series of tests has recently been made on a 150-horse-power Fairbanks-Morse engine and anthracite producer, for continuous runs of twenty-four hours, at one-quarter load, one-half load, three-quarters load and full load, the object being to determine the comparative economy at different loads. The coal used was an ordinary grade of buckwheat Pennsylvania anthracite, running rather high in ash, the analysis being as follows:

Fixed carbon	78.9 per cent.
Volatile	5.3 "
Ash	13.0 "
Moisture	2.7 "
Sulphur	0.77 "
B.T.U. per pound as fired, 13,590.	

Some of the results of these tests, including the coal consumption per brake-horse-power-hour, are given below:

Load.	B.H.P. on Engine.	Speed, R.P.M.	Coal in 24 Hours.	Coal per B.H.P. per Hour.	Cooling Water per B.H.P. Hour. Gals.	Steam per pound of Coal. Lbs.
Full	149.4	224	3838	1.07	5.0	0.48
¾	113.1	226	3185	1.13	5.6	0.45
½	75.4	226	2369	1.3	6.8	0.41
¼	38.0	228	1590	1.74	13.1	0.35

A New Line of Cigar Lighters for Continuous and Intermittent Service.

Cigar lighters for both continuous and intermittent service are now being manufactured by the General Electric Company and may be obtained in the pendent, desk or table types. These cigar lighters are suitable for operation on either alternating or direct-current circuits and may be readily connected to any ordinary lamp socket.

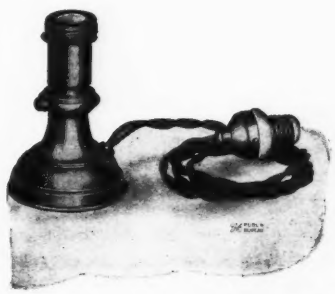
For intermittent service, both the pendent and table types are available, but the pendent type only is suitable for continuous operation. Those for intermittent service are equipped with a push-button for closing the circuit during the period of operation, which is generally from four to six seconds. The continuous service lighters are normally left in circuit but have a small switch for turning the current off when not in use.

The heating unit is somewhat similar in appearance to the ordinary fuse plug, and for intermittent service consists of several lengths of coiled wire lightly cemented to a thin sheet of insulating compound. The ends of the wire are connected to terminal screws in the porcelain plug base which is screwed into a socket in the body of the lighter. A thin piece of perforated mica, placed in a metal cap fitted to the porcelain plug base, protects the heating coils. To light the cigar or cigarette it is only necessary to place the end against the perforated disc, the hot air, drawn through the holes in the mica, igniting the cigar even before the mica disc becomes red.

The intermittent desk type, as shown in the illustration, is compact and simple in design, the heating element being similar to that used in the intermittent pendent type.

The construction of the plug for continuous service is similar to that for intermittent service, except that the coils of wire are completely filled with cement between turns. With this unit no mica covering is used, as a perforated insulating compound placed on the top of the heating unit conducts the heat to the cigar. As will be noted in the illustration, these plugs are surrounded by a perforated metal mouthpiece which protects the plug and also prevents the liability of any one being burned by coming in direct contact with the heating element. In this type of cigar lighter the heating plug can not be removed without the use of a special spanner. This feature is of special importance when the lighters are used in public places such as hotels, cigar stores, etc.

These cigar lighters are made for voltages from ninety-five to 125 volts. The power consumption is very low, being seventy-five watts for the intermittent type and twenty-five watts for the continuous type. The cost of operation and the life have been determined after a series of careful tests. It was found that with the intermittent type 1,000 lights



DESK OR TABLE TYPE CIGAR LIGHTER FOR INTERMITTENT SERVICE.

could be obtained at an approximate cost of one cent where power is sold for ten cents per kilowatt-hour. The continuous-service lighter can be operated at a cost of about three cents per day. The durability tests show that the intermittent type will give about 22,000 lights before deterioration of the heating element occurs. Tests now being conducted on the continuous-

PENDENT TYPE CIGAR LIGHTER FOR INTERMITTENT SERVICE.

PENDENT TYPE CIGAR LIGHTER FOR CONTINUOUS SERVICE.

service types show a maximum of over 5,000 hours at the present time. These tests are still in progress, so that this value will be exceeded.

The cigar lighters of the intermittent type are finished in oxidized copper, the continuous-service types being given a nickel-plated finish. All types are furnished with a suitable cord and attaching plugs.

The American Association of Electric Motor Manufacturers.

A meeting of the American Association of Electric Motor Manufacturers will be held at the Frontenac, Frontenac, N. Y., in the Thousand Islands, on September 9, 10 and 11. This association was organized at Hot Springs, Va., a few months since, the membership consisting of three classes, as follows: Class A, manufacturers of direct-current motors up to and including fifty horse-power; Class B, manufacturers of alternating-current motors up to and including fifty horse-power; Class C, manufacturers of all types of motors above fifty horse-power.

The following officers have been elected: President, S. L. Nicholson, Westinghouse Electric and Manufacturing Company, Pittsburg, Pa.; vice-president, Class A, C. F. McGilvray, Robbins & Myers Company, Springfield, Ohio; vice-president, Class B, R. J. Russell, Century Electric Company, St. Louis, Mo.; vice-president, Class C, F. S. Hunting, Fort Wayne Electric Works, Fort Wayne, Ind.; secretary, J. C. McQuiston, Westinghouse Companies' Publishing Department, Pittsburg, Pa. Executive committee: C. W. Holtzer, Holtzer-Cabot Electric Company, Brookline, Mass.; C. H. Roth, Roth Brothers & Company, Chicago, Ill.; B. C. Kenyon, Diehl Manufacturing Company, Elizabethport, N. J.; J. C. Hobart, Triumph Electric Company, Cincinnati, Ohio; James Burke, Burke Electric Company, Erie, Pa.; W. A. Layman, Wagner Electric Manufacturing Company, St. Louis, Mo.; J. W. Ham, General Electric Company, Schenectady, N. Y.; A. H. Whiteside, Allis-Chalmers Company, Philadelphia, Pa.; A. L. Doremus, Crocker-Wheeler Company, Ampere, N. J.

Business Getting with the Tungsten Lamp at Lowell, Mass.

J. H. Hunnewell, general superintendent of the Lowell (Mass.) Electric Light Corporation, is conducting an energetic business-getting campaign, using the rental of tungsten lamps and free wiring as his most important persuasions. General Electric tungsten lamps are being rented on a basis of twenty-five cents per month per lamp using 100-watt, eighty-candle-power, and the sixty-watt, forty-eight-candle-power sizes. The rental price includes the lamp, shade and holder and whatever pendent or fixture is necessary. The plan is working so successfully that at present there have been in the neighborhood of 700 lamps installed and the business is increasing rapidly.

Current Electrical News

DOMESTIC AND EXPORT.

POWER PLANT ON COOSA RIVER—A water-power development is proposed at Lock No. 2, on the Coosa River, near Gadsden, Ala. The company behind the scheme is the Coosa River Electric Power Company, of Anniston, Ala. Roswell H. Cobb, a banker of Anniston, is the president. A survey of the Coosa River at Lock No. 2 is being made by Captain Harley B. Ferguson and a corps of engineers for the purpose of securing data for the War Department in connection with the development of the proposed new company. It is planned to develop 30,000 horse-power. The next convening Congress will be asked for certain privileges in connection with this proposition.

LOUISVILLE RAILWAY COMPANY TO ISSUE NEW STOCK—Following the action taken at a meeting of the stockholders of the Louisville (Ky.) Railway Company, several months ago, authorizing an increase in the capital stock of the company, amended articles of incorporation have been filed by the company increasing the capital stock $500,000. The increase is for the purpose of reimbursing the Louisville Traction Company for funds advanced to the Louisville Railway Company several months ago. The new capitalization will be common stock, of a par value of $100. The articles of incorporation contain the names of T. J. Minary, president of the company; John Stites, Charles T. Ballard, Harry Bishop, Sam Casseday and Alex. P. Humphrey.

TO BUILD MONTANA ELECTRIC LINE—Articles of incorporation of the Billings & Cooke City Electric Railway Company have been filed. The capital stock of the organization will be $5,000,000, the principal place of business Billings and the terms of its legal existence forty years. The company will build and equip an electric railroad which will extend from Billings to Cooke City, Mont., passing through Laurel, Park City and possibly Columbus, up the Stillwater Valley to the mining camp. Those interested in the company are: J. B. Clayberg, of Helena; M. E. Estep, of Chicago, Ill.; E. M. Hosky, of Helena; George E. Savage, of Butte; Thomas Harney, of Galena, Ill., and A. L. Babcock, B. G. Shorey and Theodore Martin, of Billings.

MINNESOTA POWER PROJECT—The Backus-Brooks interests at International Falls, Minn., have sold their water-power holdings at the falls to eastern parties, and it is understood that the development hereafter will be carried on with capital furnished by the steel interests. W. H. Cook, president of the Duluth, Rainy Lake & Winnipeg road, has notified Minneapolis lumber interests that work will begin at once looking to the completion of works that will produce 30,000 horse-power within a year. This, it is understood, will be followed by the completion of new railroad lines in the district. It is understood that the Backus-Brooks company will concentrate its efforts upon the completion of a paper and pulp plant on the American side at International Falls. Pulp wood is plentiful in that locality, and the mill is to be finished by the time the power is ready to be delivered. The plant will have a capacity of 500 tons of paper a day.

CONSOLIDATION OF MEXICAN ELECTRICAL COMPANIES—It is announced that the Mexico Street Railway Company and the Mexican Light and Power Company are to be amalgamated, and one company is to control the light and power supply of Mexico City. Plans for the amalgamation are now being prepared, and a special stockholders' meeting of the light and power company will be called in the near future to arrange the details. The Mexican Light and Power Company was organized about two years ago as a consolidation of all the light and power companies in the city. There is a small power-house at Noanalco, while the main power plant is at Necaxa, on the state line between Hidalgo and Puebla, 100 miles east of Mexico City. The company is to build a second power plant near Necaxa. The stock of the company is held largely in Scotland and Germany. It is a Canadian concern. The Transvias Electricas Mexicanas, or the street railway company, is a Canadian corporation, but the stock is owned largely by F. S. Pearson, of New York city. The company was originally largely British, Wehrner, Beit & Company, of London, owning a controlling interest. It was this company which sold out its interest to Pearson and his associates.

ELECTRIC LIGHTING.

LIMA, OHIO—The city council has passed an ordinance providing for a $105,000 municipal electric light plant.

NEWARK, N. J.—The local water company is considering the installation of machinery to furnish electric light to the village.

CANTON, N. Y.—The Canton Electric Light and Power Company has purchased land upon which it will erect a transformer substation.

BENBOW, ILL.—The Benbow village board has granted a twenty-year franchise to the Benbow City Light, Heat and Power Company. A $60,000 plant will be erected.

SAN BERNARDINO, CAL.—The Redlands Gas and Electric Company has applied for permission to run transmission lines over the county roads between this city and Redlands.

SPRINGFIELD, MASS.—The new power plant of the United Electric Company, which cost approximately $300,000, has been placed in operation, adding 3,000 horse-power to the company's capacity.

HUNTSVILLE, ALA.—Fred A. Howe, a business man of this city, has secured a franchise from the city council of Gurley allowing him to establish and operate an electric light and power plant in that town.

CENTER, TEX.—Fire on August 13 destroyed the electric light plant, planing mill and 150,000 feet of lumber belonging to Redditt, Fleshman & Hardrider. There was no insurance and the loss is about $150,000.

BUCYRUS, OHIO—The Bucyrus city council has decided to build a municipal lighting plant. The proposition means the investment of $90,000. Bonds will be issued to cover the cost and the plant will be started at once.

ELWOOD, IND.—The sale of all property of the Citizens' Heat and Light Company has been ordered by Judge Greenlee, of the Superior Court. The sale will be made by the receiver, the Elwood Trust Company, at the court-house on September 18.

DODGEVILLE, WIS.—The Dodgeville Electric Light and Power Company will build a plant on the railroad land just south of the Illinois Central passenger station. The building will measure forty by seventy feet. It is likely that a heating plant and an ice plant will also be operated.

FREEHOLD, N. J.—David H. Smith, of Jamesburg, as receiver of the Manalapan Light Company, sold the property of that corporation at public sale to W. J. Lansley, of Perth Amboy, the promoter and one of the largest creditors of the concern, on a bid of $500. There is $25,000 worth of bonds outstanding.

OLYPHANT, PA.—Five prominent business men of Olyphant have been appointed by the borough council to operate the municipal lighting plant. There has been a movement to sell or lease the plant. It was claimed that the borough would have to issue $15,000 worth of bonds to put the plant in good shape.

DANVILLE, PA.—The borough council has decided to grant a franchise to C. F. Kloss and Joseph M. Watts, promoters of a new electric light company which purposes to transmit to this city electricity generated on the West Branch of the Susquehanna, the plant to be in operation within two years of the granting of the

franchise. The company will furnish light to business places at a rate not to exceed six cents per kilowatt-hour and to private residences at a rate not to exceed eight cents per kilowatt-hour.

DOVER, N. J.—The new ten-year street lighting contract with the Dover Electric Light Company has been signed by the mayor, town clerk and the officials of the electric light company. The agreement requires the town to use at least seventeen arc lamps at $85 each and 240 incandescent lamps at $17 each a year.

LOGANSPORT, IND.—Professor J. Walter Esterline, of Purdue University, who has been preparing plans for a municipal light plant for Logansport, has completed his work and submitted his report. The plans call for the expenditure of $39,540, and an ordinance has been passed by the city council appropriating this amount.

HARTFORD, WIS.—The city is preparing the site of the municipal electric light plant for the erection of the building by moving the Raaschke House. The work of putting up the power-house will be commenced as soon as the contracts are let, which will be in a short time. City Engineer Maltby has completed work on the plans.

BATH, N. Y.—C. K. Tower, of the Citizens' Electric Service Company of Bath, which has had its application for permission to build a new electric power and light plant here granted by the Public Service Commission, states that the company will proceed at once to build its power plant and to do the necessary wiring for the street lighting service.

BARNESVILLE, GA.—The city council has accepted the contract for the installation of the new electric light plant, and the new machinery will be shipped and set up within the next fifty days. The city has twice outgrown its plant, and larger generators, electric and water machinery were required. The cost of the new equipment will be about $7,000.

ALBANY, ORE.—Articles of incorporation have been filed for the Lebanon Electric Light and Water Company, which will henceforth own and operate the light plant and water system in Lebanon. The incorporators are S. P. Bach, Samuel M. Garland, J. C. Mayer, P. M. Scroggins and S. I. Stewart. All of the incorporators except Mr. Stewart are residents of Lebanon.

SAN ANGELO, TEX.—Al Reynolds, of Oklahoma, announces his intention of applying to the city council for a franchise for an electric light system in San Angelo. He represents an Ohio company, and states that if a franchise is obtained the company will expend $150,000 on the plant, which he will manage. Mr. Reynolds is superintending the electric work on the street-car system.

HASTINGS, NEB.—A report has been made by the city treasurer showing that the city electric lighting plant, since it was established by the city in 1901, has twice paid for itself. The city during that time has saved $56,000 in street lighting alone, while the profit on lighting private residences and business concerns has been sufficient to not only maintain the plant, but also to make numerous extensions and install new machinery from time to time. There is a balance of $12,000 now to the credit of the lighting fund.

HICKORY, N. C.—A meeting of the citizens of Hickory was held recently for the purpose of submitting the proposition of developing the water power at what is known as the Horseford Shoals on the Catawba River, two and one-half miles from Hickory. A stock company was organized a few weeks ago to develop this power and engineers employed to make surveys. It is considered possible to develop 6,000 horse-power at a minimum cost owing to the adaptability of the site for such development. All the stock necessary, with the exception of $20,000, has been subscribed to develop 3,500 of the 6,000 horse-power available.

IOWA CITY, IOWA—Franklin Benjamin, of Galesburg, Ill., the new owner of the American Cereal Company's plant at Coralville, proposes to take on the Iowa City municipal contract to light the city with electricity and gas. He desires to build an electric light plant at Coralville and a gas plant in Iowa City. Mr. Benjamin offered the city council the entire equipment of the electric light plant, as a bonus, after twenty-five years, the gift of the poles, wires, equipment, etc., being limited to sufficient to supply the city's needs, as they stand at the end of twenty years. If the city prefers Mr. Benjamin agrees to deposit $1,000 a year in a bank (he to draw the interest thereon), and at the end of the twenty-five years the $25,000 is to go to Iowa City if he retains the plant.

ELECTRICAL SECURITIES.

For a brief period, early in the week, it appeared as if there might ensue a break in prices, due to the bewildering turn affairs had taken when in a terrific effort to bear the market one large brokerage firm brought down suspension from the Stock Exchange upon its head. The heavy interests, however, were able to meet the raid and prices were maintained, with everything proceeding in a most orderly manner all through the week. The most favorable indications at present are the feeling of general hopefulness for an early activity in business, the excellent condition of freight railroads to cope with any reasonable improvement in tonnage, the little real damage suffered through storm and flood by the crops, and the large surplus being stored up in banks all over the country—in fact, all over the world, as is reflected in recent reports.

Dividends have been declared upon the following electrical securities: Louisville (Ky.) Railway Company; semiannual dividend of 2½ per cent on the preferred and a quarterly dividend of 1 per cent on the common, payable October 1. Galveston-Houston (Tex.) Electric Company; semiannual dividend of $3 per share on the preferred stock, payable September 15. General Electric Company; regular quarterly dividend of $2 per share, payable October 15 to stock of record September 9. Rochester (N. Y.) Railway and Light Company; regular quarterly dividend of 1¼ per cent on the preferred stock, payable September 1. Mackay Companies; regular quarterly dividends of 1 per cent on the preferred and 1 per cent on the common, payable October 1 to stock of record September 12. Northern Ohio Traction and Light Company; two quarterly dividends of ¼ of 1 per cent each, payable on the $8,938,900 capital stock on September 15 and December 15, 1908, to holders of record September 1 and December 1, respectively. This reduces the annual rate to a 1 per cent basis, comparing with a 2 per cent rate maintained from June 15, 1906, to June 15, 1908.

ELECTRICAL SECURITIES FOR THE WEEK ENDED AUGUST 29.

New York:	*Closing.*
Allis-Chalmers common	11¾
Allis-Chalmers preferred	35½
Brooklyn Rapid Transit	53¾
Consolidated Gas	145½
General Electric	146
Interborough-Metropolitan common	11¾
Interborough-Metropolitan preferred	33¾
Kings County Electric	122
Mackay Companies (Postal Telegraph and Cables) common	68
Mackay Companies (Postal Telegraph and Cables) preferred	68
Manhattan Elevated	139
Metropolitan Street Railway	30
New York & New Jersey Telephone	110
Western Union	55¼
Westinghouse Manufacturing Company	74

Boston:	*Closing.*
American Telephone and Telegraph	126½
Edison Electric Illuminating	225
Massachusetts Electric	47
New England Telephone	117¼
Western Telephone and Telegraph preferred	70

Philadelphia:	*Closing.*
Electric Company of America	9⅞
Electric Storage Battery common	37
Electric Storage Battery preferred	37
Philadelphia Electric	9¾
Philadelphia Rapid Transit	14
United Gas Improvement	87¾

Chicago:	*Closing.*
Chicago Telephone	—
Commonwealth Edison	105
Metropolitan Elevated preferred	40
National Carbon common	69
National Carbon preferred	108

NEW INCORPORATIONS.

CLEVELAND, OHIO—Buffalo Valley Telephone Company, Cumberland. $1,000.

DENVER, COL.—Municipal Lighting Company. Incorporators: Carl Christensen and Carl Vogt. $100,000.

NEWARK, N. J.—Arcade Block Lighting Company, Newark. To manufacture electricity, etc., for light, heat and power; fixtures, etc. $40,000. Incorporators: J. O. Sharpe, T. A. Phillips, F. J. Greenberg, Newark.

PERSONAL MENTION.

MR. WALTER P. SCHWABE has resigned as superintendent of the Rutherford (N. J.) office of the Public Service Corporation of New Jersey.

MR. W. D. SHALER has been elected secretary of the Doubleday-Hill Electric Company, Pittsburg, Pa., to fill the place made vacant by the decease, recently, of his brother, Mr. H. G. Shaler.

OBITUARY NOTE.

MR. JOHN JAMES GREENOUGH, inventor and former superintendent of the Patent Office at Washington, died recently at the home of his daughter in Brookline, Mass. He was the first to take out a patent on a sewing machine, invented the first shoe-pegging machine and assisted in the construction of the first electric locomotive. He held the position of superintendent of the Patent Office from 1837 until 1841. In 1853 he commenced the publication of the *American Polytechnic Journal*. He was born in Boston, January 19, 1812.

ELECTRIC RAILWAYS.

HUNTSVILLE, ALA.—The city council has granted Ed. L. Pulley and associates a franchise to construct and operate an electric car line.

RIVERSIDE, CAL.—The Riverside & Arlington Railway Company has been granted a franchise by the city council. This includes a freight-carrying privilege.

SALT LAKE CITY, UTAH—The Utah Light and Railway Company is planning extensions of its lines throughout Salt Lake and Utah valleys and as far south as Provo.

PITTSBURG, PA.—The Pittsburg & Beaver Street Railway Company, which proposes to construct a line from Pittsburg to Beaver on the populous south side of the Ohio River, has increased its capital from $60,000 to $235,000.

YAZOO CITY, MISS.—A street railway is now assured for Yazoo City. The bonds which were issued about a year ago have been signed and delivered and the money paid over to the city treasurer. In ninety days it is thought the road will be in operation.

BLOOMINGTON, ILL.—General Manager Fischer, of the Illinois Traction System, is authority for the statement that in two years' time the traction system will be connected with Terre Haute and extended on into Indiana, transferring to the Indiana interurban lines.

DUNKIRK, N. Y.—The Buffalo & Lake Erie Traction Company has awarded to Peter B. Colgan, of this city, the contract for excavating and clearing the roadbed for trolley extension from Cassity's Woods to Sheridan to connect with the main line from the belt line system.

ALBANY, N. Y.—The Public Service Commission, Second District, has granted the application of the Western New York & Pennsylvania Traction Company for permission and approval to construct an extension of its road in the village of Salamanca to and into the village of Little Valley.

SALISBURY, N. C.—The Piedmont Electric Car Line Company, of this city, has been granted a franchise to build an electric line skirting Salisbury on the north and west, the work to begin within six months. The same company proposes to connect Spencer and East Spencer by an electric line.

MOBILE, ALA.—Within sixty days engineers will begin work surveying the proposed route of the electric line from Citronelle to Mobile, and inside of one year cars will be operating into Mobile from Citronelle, according to George S. Bressler, of Gulf Crest, Ala., who is interested in the proposition.

DUNKIRK, N. Y.—A syndicate of Buffalo capitalists is said to be planning the construction of the long-awaited Cassadaga Valley trolley line over the proposed route from Dunkirk as far south as Sinclairville. According to the report, the new trolley line will take in all the villages down the Cassadaga Valley, including Stockton.

CHILLICOTHE, OHIO—The Scioto Valley Traction Company is completing the work of extending its line to the business section of Chillicothe. The overhead work is now being put up, and within a short time the company will be operating cars from Columbus to the business district of the city.

WASHINGTON, PA.—Burgess A. V. Lewis, of Donora, has returned to the council with his signature the ordinance granting a franchise to the Donora-Eldora Street Railway Company. The company has thirty days in which to file its bond of $5,000, three months in which to start work and one year in which to complete the road from Donora to Eldora.

HUNTSVILLE, ALA.—The question of building an electric railway from this city to Monte Sano is being agitated. Several business men have secured eighty acres of land on the top of the mountain and it will be divided into 200 lots and sold. The funds realized from this sale will be used as a nucleus with which to push the electric railway project.

BERKSHIRE, MASS.—The Berkshire Street Railway Company has petitioned the State Railroad Commission for authority to issue $80,000 additional capital stock, $40,000 each for extensions in Pittsfield and improvements to the line between North Adams and Williamstown. With the petition of April 28 this would make $365,000 new stock. The market value is fixed at $100 per share.

NORTH VANCOUVER, B. C.—At a meeting of the district council, at which there were present Acting General Manager T. W. Glover and Local Manager W. B. Bunbury, of the British Columbia Electric Railway Company, arrangements were completed for the extension of the lines of the company up Capilano Valley to the second cañon. The line will be in operation next spring.

HOUGHTON, MICH.—The Houghton County Traction Company, of Houghton, Mich., has contracted with the Stone & Webster Engineering Corporation for the extension of its lines from Wolverine to Mohawk, Mich. The contract includes the construction of the track, bridges, overhead work, a car barn, a small substation and the purchase of some new cars. The work as planned will cost about $125,000.

SEYMOUR, IND.—The Seymour & Brownstown Construction Company has been organized to construct an electric railway between Seymour and Brownstown, a distance of twelve miles. Indianapolis and Marion men are interested with local men in the enterprise. The company has asked for right of way through this city. The proposed line will connect with the Indianapolis & Louisville traction lines in Seymour.

MARQUETTE, MICH.—According to the officers of the Marquette, Negaunee & Ishpeming Interurban Railway Company, an active start will be made with the grading of the right of way between this city and Negaunee within the next few weeks. Some work has already been done at the Marquette end of the right of way. The operations now projected, however, are to be carried out on a large scale, and it is hoped that they will result in having the line ready for traffic by June of next year.

NEW CASTLE, PA.—The Mahoning & Shenango Railway and Light Company has secured the passage of an ordinance extending its franchise thirteen years, making it expire in twenty-five years. For the extension the company gives a rate of twenty-five tickets for $1, universal transfers and a partial guarantee of better service. It also agrees to extend the transfer and city fare. The present traction franchises have a life of twelve years, and on the Park and Falls line there is a fare of twenty-seven tickets for $1. On other lines the fare is twenty-two tickets for $1.

MINNEAPOLIS, MINN.—Articles of incorporation of the Electric Short Line Railroad Company have been filed. The principal place of business is given as Minneapolis. The incorporators are: Severen Solverson, who is secretary of the Phoenix Loan and Investment Company; E. C. Hinde, of Sioux Falls, S. D.; Frank E. Reed, of Glencoe. In order, they hold the offices of president, vice-president, and secretary. It is stated that the purpose is to put in good form the properties of an organization which has been in existence for five years, and that the incorporation has no significance as to any immediate activity of the company in railroad building.

BUTLER, PA.—Surveys of a route for an electric line projected by Butler, Pittsburg and Franklin capitalists to connect Butler and Conneaut Lake have been begun. The proposed line will be seventy

miles long and will form the conecting link between Pittsburg and Erie and Buffalo by trolley. It is asserted that the backers of the venture are friendly with the interests owning the Pittsburg & Butler Street Railway Company. The route already selected from Butler is by way of Oneida, Queens, Euclid, Slippery Rock, Grove City, Greenville, to Conneaut Lake, with a branch to Franklin to connect with the Oil City line. From Conneaut Lake to Erie is a continuous line over the roads through Saegertown and Cambridge Springs to Erie and Buffalo.

SAN JOSE, CAL.—The Southern Pacific Company has purchased from L. S. Hanchett, of San José, the Santa Clara Interurban Railroad Company's property, including rights of way for a railway between Santa Clara and San Mateo. The purchaser intends to build at once and to operate an electric railway between Santa Clara and San Mateo, thus giving San José electric railway connection with San Francisco. The rights of way purchased by the Southern Pacific constitute a private property. The Santa Clara Interurban Railroad Company built and equipped the electric railway system in Palo Alto. This system, including a power-house and all the tracks, rolling stock and other property connected with it, was purchased by the Southern Pacific. The estimated value of this property is about $500,000. The Southern Pacific proposes to build first between Santa Clara and San Mateo. Between Santa Clara and Palo Alto the route of the private right of way is along the county road. It is not stated just when the construction of the first portion of the road will begin, but it will be at an early date. Later the line will be extended between San Mateo and San Francisco. For this line the route of the old steam line by Mission Hill, that was in use by the Southern Pacific before the building of the Bay Shore cutoff, will be utilized.

DATES AHEAD.

Pennsylvania Electric Association. First meeting, Eagles' Mere, Pa., September 8-9.

American Association of Electric Motor Manufacturers. Next meeting, Frontenac, N. Y., September 9-11.

Association of Edison Illuminating Companies. Annual meeting, Lenox, Mass., September 15-17.

Colorado Electric Light, Power and Railway Association, Glenwood Springs, Col., September 16-18.

Arkansas Association of Public Utilities Operators. First annual convention, Little Rock, Ark., September 17-18.

Old Time Telegraphers' and Historical Association, and Reunion of Military Telegraphers, Niagara Falls, N. Y., September 16-18.

Illuminating Engineering Society. Annual convention, Philadelphia, Pa., October 5-6.

Kansas Gas, Water, Electric Light and Street Railway Association. Annual meeting, Pittsburg, Kan., October 8-10.

American Street and Interurban Railway Association. Annual convention Atlantic City, N. J., October 12-16.

American Street and Interurban Railway Accountants' Association. Annual convention, Atlantic City, N. J., October 12-16.

American Street and Interurban Railway Claim Agents' Association. Annual convention, Atlantic City, N. J., October 12-16.

American Street and Interurban Railway Engineering Association. Annal convention, Atlantic City, N. J., October 12-16.

American Street and Interurban Railway Manufacturers' Association. Annual convention, Atlantic City, N. J., October 12-16.

Railway Signal Association. Next meeting, Chicago, Ill., September 8. Annual meeting, Washington, D. C., October 13-15.

American Electrochemical Society. Fall meeting, New York city, October 30-31.

Order of the Rejuvenated Sons of Jove. Annual meeting, Buffalo, N. Y., October 15-16.

American Society of Municipal Improvements. Annual meeting, Atlantic City, N. J., October 20-23.

EDUCATIONAL NOTE.

EVENING TECHNICAL COURSES AT THE POLYTECHNIC INSTITUTE OF BROOKLYN—The Polytechnic Institute, of Brooklyn, N. Y., announces evening technical courses in its College of Engineering for the season of 1908-1909. There will be a series of evening and Saturday courses in engineering, chemistry, physics, mathematics, drawing, history, economics and languages, especially designed to afford men in active practice opportunities for professional study. The term of study begins on Thursday, October 1, and continues until the various courses are completed. These courses may be taken independently or in connection with the regular work of the courses in engineering leading to the degrees of civil engineer, electrical engineer, mechanical engineer, chemical engineer or bachelor of science in chemistry.

NEW PUBLICATIONS.

THE STUDY OF SCIENCE BY YOUNG PEOPLE—A very interesting paper, entitled "The Study of Science by Young People," by Dr. William S. Franklin, of Lehigh University, has been reprinted from the proceedings of the twelfth annual meeting of the New York State Science Teachers' Association.

BIBLIOGRAPHY OF ELECTROCHEMISTRY AND ALLIED SUBJECTS—A bibliography of electrochemistry and allied subjects has been prepared by P. F. Mottelay. This compilation constitutes Appendix i of the author's "Bibliographical History of Electricity and Magnetism," which will shortly appear in book form.

INSTITUTION OF ELECTRICAL ENGINEERS—The *Journal of the Institution of Electrical Engineers*, of Great Britain, published under the supervision of the editing committee, and edited by George C. Lloyd, secretary, has been published by the house of E. & F. N. Spon, 57 Haymarket street, London, S. W. The New York publishers are Spon & Chamberlain, 123 Liberty street. The present volume contains the proceedings of March 19 and April 2, 9, 23 and 30. There are published as a supplement the accessions to the library from January 1 to June 30, 1908.

INDUSTRIAL ITEMS.

FOX BROTHERS & COMPANY, 126 Lafayette street, New York city, have published a handsome series of bulletins devoted to "Polar" flaming arc lamps, "Carbone" lamps, "Radiante Economy" and "Radiante" lamps, standard show-window lighting, technical data, and tungsten incandescent lamps.

THE HOLOPHANE COMPANY, New York city, in the August issue of "Holophane," makes an interesting special announcement concerning the Holophane D'Olier metal reflector. The Holophane Company has acquired, and will hereafter have exclusive control of, the metal reflectors designed by, and manufactured under the patents of, Henry D'Olier, Jr.

THE GENERAL ELECTRIC COMPANY, Schenectady, New York, has issued bulletin No. 4,597, devoted to Thomson astatic instruments for continuous-current switchboards. Bulletin No. 4,575 is devoted to Type F, Form K-7 oil-break switches. Bulletin No. 4,596 is devoted to enclosing globes for arc lamps. Copies of this bulletin will be furnished to those interested upon request.

THE ROCKWELL FURNACE COMPANY, New York city, has published two handsome catalogues devoted, respectively, to portable heaters for heating work which is too bulky or inconvenient to remove to a furnace, and where it is desirable to take the heater to the work, such as annealing, hardening, expanding, bending, brazing, skin-drying, lead melting and rivet heating; and to melting furnaces for melting all metals, tinning, galvanizing, tool hardening, and all operations requiring molten metal and other heated baths.

THE CONSOLIDATED ELECTRIC LAMP COMPANY, Danvers, Mass., announces that although its main factory and stock were seriously damaged by the fire which occurred on August 14, it is in a position to take care of orders from its Pine street factory. The company has already perfected plans for a larger and thoroughly equipped building, to be completed before the winter sets in. As the fire occurred in the quiet season, the company was not so greatly inconvenienced as it otherwise would have been. The loss caused is estimated at $20,000, partially covered by insurance.

THE BRISTOL COMPANY, Waterbury, Ct., is issuing two new bulletins, No. 91 and No. 93, which, with bulletin No. 92, cover the list of Bristol recording thermometers for all temperature ranges up to 800 degrees Fahrenheit. As a result of the consolidation of the business of William H. Bristol with that of the Bristol Company the latter company also manufactures William H. Bristol electric pyrometers together with the three classes of recording thermometers, which are described in the bulletins above mentioned. Copies of these bulletins will be furnished to those interested upon request.

THE TRIUMPH ELECTRIC COMPANY, Cincinnati, Ohio, has published a little brochure entitled "The Way to Forget." After treating the subject in a rather airy fashion the reader is made

acquainted with the fact that the best way for a manufacturer to forget is to select everything in the plant, from the motor to the manager, of a character that will not, under ordinary conditions, do anything but the work intended. The only way to avoid experiences that create unforgettable memories is to get the right sort of a motor. The suggestion is, of course, that the right motor or dynamo is built by the Triumph Electric Company.

THE CENTRAL ELECTRIC COMPANY, Chicago, Ill., is distributing its new bulletin describing the P.-A. electrically operated remote-control switch for use in controlling lights and power from a distance. A full description is given of the switch mechanism, together with some of the various applications. The company is also distributing bulletin No. 10, illustrating and describing the "O. K." fuse block cover, for use by central stations in preventing theft of current. This block is manufactured to fit standard size Edison plug fuse blocks. A flier is also being distributed, illustrating and describing the type "B" oil switches for entrance and motor service. This switch has been designed to meet the demands for a small-capacity medium-priced oil switch for use in connection with motor and lighting circuits up to and including 3,300 volts.

THE BELDEN MANUFACTURING COMPANY, Chicago, Ill., has issued catalogue No. 4, in convenient pocket size. This catalogue contains 124 pages, is printed on fine paper, and is profusely illustrated. Great pains have been taken to procure a simple and comprehensive book on wires, cables, cordage and other electrical raw material required, particularly by users of wire. Each article listed is described and illustrated with half-tone engravings wherever possible, showing the construction and the manner in which it is prepared for shipment. A feature of special interest to electrical supply dealers is the putting up in paper cartons of such products as will permit. Annunciator wire, gas-fixture wire, resin-core solder and table push-button cords are put up for shipment in neat paper cartons. In the back of the book there are twenty-five pages devoted to wire tables and formulas useful in the design of electromagnets, resistance coils, cables, etc. Copies of this catalogue will be sent to those interested upon request.

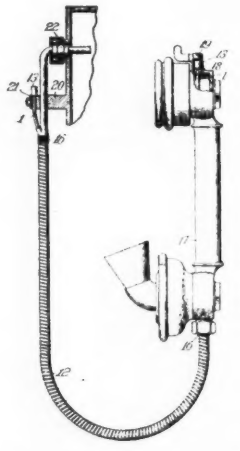
Record of Electrical Patents.

Week of August 18.

896,700. ELECTRICAL CONDUCTING CORD. George F. Atwood, East Orange, N. J., assignor to Western Electric Company, Chicago, Ill. A metal-armored cable arranged upon a strand of high tensile strength for a microphone telephone instrument.

896,705. PROCESS FOR HARDENING TANTALUM. Werner von Bolton, Charlottenburg, Germany, assignor to Siemens & Halske A. G. The process consists of heating tantalum in the presence of carbon.

896,715. FORMING OF FILAMENTS OUT OF VISCOSE OR SIMILAR VISCOUS MATERIAL. Charles A. Ernst, Lansdowne, Pa., assignor to Silas W. Pettit, Philadelphia, Pa. The cellulose xanthate is partly dissolved without precipitation in an alkaline solvent and then spun in a neutralizing solution.



896,700—ELECTRICAL CONDUCTING CORD.

896,738. REGULATOR FOR DYNAMOELECTRIC MACHINES. William C. Mayo and John Houlehan, El Paso, Tex., assignors of one-third to George E. Briggs, Barstow, Tex. A mechanical power regulator and a solenoid attachment for varying the effect of the superimposed current.

896,740. ELECTRIC TRACK BRAKE. William C. Mayo, El Paso, Tex., assignor, by direct and mesne assignments, of two-thirds to himself, and George E. Briggs, Barstow, Tex., and one-third to John Houlehan, El Paso, Tex. The electromagnet operates the brake shoe.

896,749. ELECTROCHEMICAL CONCENTRATION OF LIQUIDS. George W. Nistle, North Muskegon, Mich., and Robert L. Gifford, Chicago, Ill. The electrochemical effect concentrates the liquid.

896,752. MALTING PROCESS. Alfred Oertel, Godesberg, Germany, assignor to Diechmann & Cie., Cologne, Germany. The grain is subjected to the action of dark electric rays.

896,754. ELECTRIC SNAP SWITCH. Johann G. Peterson, Hartford, Ct., assignor to the Arrow Electric Company, Hartford, Ct. A quick-break push-button switch.

896,755. HORSE-POWER-HOUR METER. Johannes Picht, Halle-on-the-Saale, Germany. The current is varied through one coil in proportion to the pressure in the engine cylinder and through another coil in proportion to the speed of the engine.

896,764. CIRCUIT-BREAKER CONTACT. William M. Scott and Harry C. Campion, Jr., Philadelphia, Pa.; said Campion assignor to said Scott. The contact has an active member and an inactive member connected by a reinforcing electro plate.

896,784. NON-SYNCHRONOUS RECEIVING PERFORATOR. Milton T. Weston, New York, N. Y. The perforating hammer is alternately engaged and freed by electromechanical means.

896,793. ANNUNCIATOR. Edward Baum, Baltimore, Md. A combination of a visual and auditory signal.

896,796. TELEPHONE APPARATUS. Sidney A. Beyland, Elyria, Ohio, assignor to the Dean Electric Company, Elyria, Ohio. A tubular metal desk stand and support.

896,802. ELECTRODE FOR LIGHTNING ARRESTERS. Frank B. Cook, Chicago, Ill. The carbon block is finished with rough protrusions, between which is embedded a non-conducting, adhesive mixture.

896,808. RELAY. Frank L. Dodgson, Buffalo, N. Y., assignor to General Railway Signal Company, Buffalo, N. Y. The cores have enlarged and rectangular-shaped ends or poles, and means are provided for securing the cores to the carrying plate.

896,809. RELAY. Frank L. Dodgson, Buffalo, N. Y. Two permanent magnets are pivoted so as to swing in a plane at right angles to the cores of the electromagnet.

896,811. METALLIC FILM FOR USE WITH STORAGE-BATTERY ELECTRODES AND PROCESS OF PREPARING THE SAME. Thomas A. Edison, Llewellyn Park, Orange, N. J., assignor to Edison Storage Battery Company, West Orange, N. J. Nickel or cobalt films with minutely roughened or matted surfaces are provided for admixture with the active material.

896,812. STORAGE BATTERY. Thomas A. Edison, Llewellyn Park, Orange, N. J., assignor to Edison Storage Battery Company, West Orange, N. J. The supporting plate is fitted with a plurality of tongues which may be bent so that the pockets of active material may be separately removed from the plate.

896,828. SELECTIVE MECHANISM FOR TESTING DEVICES. Albert B. Herrick, Cleveland, Ohio. Plug connections are made through the medium of a punched disc and corresponding terminals, and the circuit-closing switch is interlocked with the disc.

896,830. TELEPHONE METER. Newman H. Holland, Brookline, Mass., assignor to Charles Bate, Boston, Mass. The registering meter is actuated in response to the closure of the telephone circuit at one station prior to the insertion of the plug and again upon the change in character of the current.

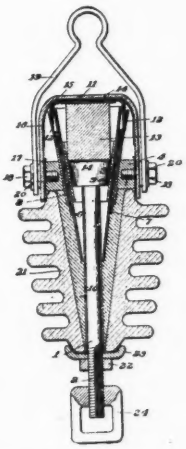
896,831. SIGNALING. Mark H. Hovey, Buffalo, N. Y., assignor to General Railway Signal Company, Buffalo, N. Y. A single signal-controlling circuit actuates a lock-controlling circuit, lock, track relay and signal.

896,832. SELECTIVE CALL APPARATUS. John A. Hulit, Topeka, Kan. A balance bar, actuated by a main lever, is adapted to throw off the holding pawl, co-operating with a ratchet selectively arranged for preventing the balance bar from throwing off the holding pawl.

896,836. TELEPHONE SYSTEM. John J. Kelly, St. Louis, Mo. Means are provided for signaling the central exchange without affecting the signal devices at the exchange.

896,838. ELECTRICAL APPARATUS. Charles J. Klein, New York, N. Y., assignor to Ralph Abraham Schoenberg, New York, N. Y. A water-tight floor receptacle.

896,839. ALARM SYSTEM AND APPARATUS. John M. Latimer, Flushing, N. Y., assignor to the Consolidated Fire Alarm Company, New York, N. Y. A closed-circuit system which operates upon interference with the normally grounded condition.



896,954.—INSULATOR.

896,840. ALARM TRANSMISSION. John M. Latimer, Flushing, N. Y., assignor to Consolidated Fire Alarm Company, New York, N. Y. A combination of rotating main character and supplemental character contacts actuated by a driven spring.

896,842. RAILWAY SIGNALING APPARATUS. William Macomber, Buffalo, N. Y., assignor to General Railway Signal Company, Buffalo, N. Y. Means are provided for forcing a signal to normal and holding the signal locked.

896,868. ELECTRICAL CLUTCH OR THE LIKE. Abram P. Steckel, Buffalo, N. Y. Oppositely disposed magnetized poles are provided in the opposing clutch members.

896,874. HOT-BOX INDICATOR. Henry Williams, Chicago, Ill. A fulminating cap actuates a contact-making device upon heating.

896,882. VIBRATORY MASSAGE DEVICE. Asa H. Arnold and Albourne F. Furbush, Poughkeepsie, N. Y. The vibratory movement is provided by the reciprocal action of the armature.

896,886. CONSTRUCTION OF ELECTROMAGNETS. Arthur F. Berry, Ealing, England. The magnetic circuit is built up of plates having axially parallel limbs connected together to embrace the inner and outer peripheral surfaces and inner end of the winding.

896,921. TORPEDO BOAT. Edward J. Kelley, Washington, D. C., assignor of one-eighth to Robert L. Nutt and one-sixteenth to Robert A. Hutchins, Jr., Portsmouth, Va. Means are provided for steering the torpedo, for actuating a visible signal, and for changing the color of the signal from a distant point.

896,930. ALARM CLOCK. Elijah McComb, Johannesburg, Transvaal. The alarm clock, cells and actuating mechanism are fitted in a cabinet with a hinged door.

896,934. INSULATOR. John P. Nikonow, East Pittsburg, Pa. The core is provided with an enlargement and a collar surrounding the enlargement, and a rain-proof insulating cap.

896,935. ARC LAMP. Ludvik Ocenasek, Prague, Austria-Hungary. As the end of a fusible pin is melted, the carbon is fed downward.

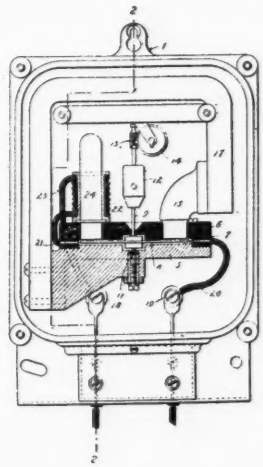
896,951. SOLDERING MACHINE FOR COMMUTATORS. Harry Stone, Wilmerding, Pa., assignor to the Westinghouse Air Brake Company, Pittsburg, Pa. The soldering tool is provided with a grooved surface, and is held in a heated receptacle equipped with means for rotating.

896,973. CHARGING SYSTEM FOR STORAGE BATTERIES. Fred B. Corey, Schenectady, N. Y., assignor to General Electric Company. An automatic switch is adapted to connect the batteries alternately to a charging conductor or to a discharging device.

896,979. FIELD REGULATION FOR MOTOR-GENERATORS. Charles E. Eveleth, Schenectady, N. Y., assignor to General Electric Company. Means are provided for simultaneously varying the speed of the motor and the field strength of the generator.

896,980. RECTIFIER PANEL. Samuel Ferguson, Schenectady, N. Y., assignor to General Electric Company. Two panels are provided on standards, one containing the rectifier apparatus and the other the circuit-connecting and measuring devices.

896,983. TRANSFORMER-CORE CONSTRUCTION. John J. Frank, Schenectady, N. Y., assignor to General Electric Company. The lamina are interleaved at the joints, and a portion of the lamina has notches located dissymmetrically at the interleaving ends.



896,999.—METER.

896,984. CONDUIT FOR ELECTRIC WIRES. Horace C. Freeman, St. Paul, Minn. A trough and a plurality of removable cover sections.

896,993. CONTROL SYSTEM FOR MOTOR-DRIVEN RECIPROCATING DEVICES. Leopold Janisch, Berlin, Germany, assignor to General Electric Company. The reciprocal motion of the motor is controlled between predetermined points.

896,999. METER. William J. Lloyd, Rugby, England, assignor to General Electric Company. The meter is equipped with a receptacle containing a conducting liquid.

897,013. METHOD OF GENERATING AND DISTRIBUTING ALTERNATING CURRENTS. Edward B. Raymond, Schenectady, N. Y., assignor to General Electric Company. Means are provided for deriving alternating current by driving the machine by mechanical power at a speed in any direction so that it runs greatly in excess of the speed corresponding to synchronism with the exciting current.

897,019. ELECTRIC CLOCK MECHANISM. George H. Rupley, Schenectady, N. Y., assignor of one-half to Frank J. Seabolt, Schenectady, N. Y. The motor circuit is closed for a predetermined period, and means are provided for disconnecting the motor from the winding mechanism when the motor circuit is opened.

897,020. ELECTRIC CLOCK WINDING MECHANISM. George H. Rupley, Schenectady, N. Y., assignor of one-half to Frank J. Seabolt, Schenectady, N. Y. The clock mechanism is connected with the motor, whether the motor circuit is open or whether the motor circuit is closed.

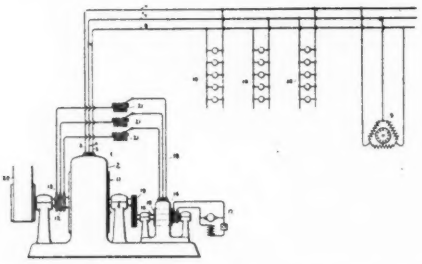
897,024. SYSTEM OF ELECTRIC METERING. Ernest Schattner, Schenectady, N. Y., assignor to General Electric Company. Means are provided for connecting the field coils in series with one or another set of translating devices.

897,028. CIRCUIT SYSTEM FOR TELEPHONE REPEATING APPARATUS. Herbert E. Shreeve, Newton, Mass., assignor to American Telephone and Telegraph Company. A combination of reinforcing circuit with an input coil.

897,031. SYSTEM OF CONTROL. Emmett W. Stull, Norwood, Ohio, assignor to Allis-Chalmers Company and the Bullock Electric Manufacturing Company. The magnet opens the switch to break the motor circuit, the magnet being energized only when the controller is moved backward to its first operative position.

897,039. PROCESS FOR PURIFYING AND FILTERING WATER. Alfred Vogelsang, Dresden, Germany. The material to be purified has small quantities of ozone added to it.

897,042. TELEPHONE SYSTEM. Alfred H. Weiss, Chicago, Ill., assignor to Kellogg Switchboard and Supply Company, Chicago, Ill. A central-energy visual-signal telephone system.



897,013.—METHOD OF GENERATING AND DISTRIBUTING ALTERNATING CURRENTS.

897,062. CABLE TERMINAL. Frank B. Cook, Chicago, Ill. A can-top terminal with means for facilitating the holding of the cover piece in place during examination.

897,084. APPLIANCE FOR USE WITH TELEPHONE TRANSMITTERS. Orrin H. Goodrich, Castleton Corners, N. Y., assignor to Edward F. Hutton, New York, N. Y. A cabinet for enclosing a telephone transmitter.

897,085. SPRING JACK FOR TELEPHONE SWITCHBOARDS. Georg Grabe, Wilmersdorf, Germany, assignor to Siemens & Halske Aktiengesellschaft, Berlin, Germany. The spring jacks are mounted on very small spacing centres.

897,110. ELECTRIC INCANDESCENT LAMP. Hans Kuzel, Baden, near Vienna, and Richard Hoke, Vienna, Austria-Hungary; said Hoke assignor to said Kuzel. A plurality of horseshoe-shaped metal filaments is supported by insulating holding devices and connected to supply wires.

897,119. TELEPHONE SIGNAL. Charles Mahler, New York, N. Y. Each branch telephone is equipped with a bell of individual tone.

897,138. SIGNAL SYSTEM. Robert Pfeil, Grunewald, Berlin, Germany, assignor to Siemens & Halske, A. G., Berlin, Germany. The setting lever has normal, intermediate and full-controlling positions.

897,147. ELECTRIC REGULATOR. Thomas M. Pusey, Kennett Square, Pa. The combination of an insulating liquid and a conducting liquid lighter than the insulating liquid resting thereupon.

897,149. BRAKE SETTER. William A. Rideout, Sr., Oshkosh, Wis. The signal is provided with a movable contact adapted to be engaged by contacts on the car.

897,166. ELECTRIC MOTOR. Wilfred Shurtleff, Moline, Ill. The groups of three poles comprising the field magnets have two small poles flanking the larger central pole.

897,186. ELECTRIC WATER HEATER. Joseph R. Ayotte, Montreal, Quebec, Canada, assignor to Jean Baptiste Albert Martin, Montreal, Canada. The heating element is contained in a metal receptacle.

897,194. LAMP-SHADE HOLDER. John Cruikshank, Shamokin, Pa. The relatively movable conical plates are provided with a plurality of gripping members interposed between the plates.

897,203. ELECTRIC FURNACE. Johannes Härdén, London, England, assignor to the Gröndal Kjellin Company, Limited, London, England. A primary coil is positioned on an iron frame in inductive relation to an annular fusion chamber.

897,211. PROTECTIVE DEVICE FOR ELECTRICAL SYSTEMS. Karl Kuhlmann, Berlin, Pankow, Germany, assignor to General Electric Company. The conductors of a polyphase electrical system are provided with a resistance and safety device connecting each conductor with each other conductor of the system, and a low reactance path to ground from the junction of each safety device and its corresponding resistance.

897,212. LIGHTNING ARRESTER. Karl Kuhlmann, Berlin, Pankow, Germany, assignor to General Electric Company. A multigap, variable-resistance arrester.

897,215. ELECTROMAGNETIC SWITCH. William MacMillan, New York, N. Y. The switch is automatically locked or unlocked by means in the controlling circuit.

897,226. MEANS FOR GENERATING AND DISTRIBUTING ALTERNATING CURRENTS. Edward B. Raymond, Schenectady, N. Y., assignor to General Electric Company. The alternating-current generator has two relatively movable members, each provided with a multiphase winding. A resistance in the circuit of the exciter is used for varying the compounding action of the generator.

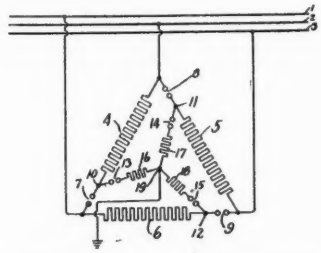
897,232. TELEPHONE SYSTEM. Harry G. Webster, Chicago, Ill., assignor to Milo G. Kellogg, Chicago, Ill. Means are provided at the subscriber's station to control the flow of current in the line.

897,233. TELEPHONE-EXCHANGE SYSTEM. Harry G. Webster, Chicago, Ill., assignor to Milo G. Kellogg, Chicago, Ill. The signal is displayed when the line circuit is closed at the substation.

897,234. TELEPHONE SYSTEM. Harry G. Webster, Chicago, Ill., assignor to Milo G. Kellogg, Chicago, Ill. Means are provided at the subscriber's station to determine the current flowing in the line.

897,235. TELEPHONE SYSTEM. Harry G. Webster, Chicago, Ill., assignor to Milo G. Kellogg, Chicago, Ill. The signal-receiving electromagnet associated with the line has an energizing winding of low energizing capacity normally in circuit.

897,236. TELEPHONE SYSTEM. Harry G. Webster, Chicago, Ill., assignor to Milo G. Kellogg, Chicago, Ill. A switch is provided at the substation for controlling the flow of current over the line through the substation.



897,211.—PROTECTIVE DEVICE FOR ELECTRICAL SYSTEMS.

897,237. TELEPHONE SYSTEM. Harry G. Webster, Chicago, Ill., assignor to Milo G. Kellogg, Chicago, Ill. A central station provided with a link circuit.

897,238. TELEPHONE SYSTEM. Harry G. Webster, Chicago, Ill., assignor to Milo G. Kellogg, Chicago, Ill. The system is provided with a repeating coil for inductively uniting the line to the terminal.

897,239. TELEPHONE SYSTEM. Harry G. Webster, Chicago, Ill., assignor to Milo G. Kellogg, Chicago, Ill. The polarized repeating coil relay has windings inductively uniting the line to the terminal.

897,240. TELEPHONE SYSTEM. Harry G. Webster, Chicago, Ill., assignor to Milo G. Kellogg, Chicago, Ill. The repeating coil relay is controlled solely by the subscriber, having windings inductively uniting the line to the terminal.

897,241. TELEPHONE SYSTEM. Harry G. Webster, Chicago, Ill., assignor to Milo G. Kellogg, Chicago, Ill. The talking circuit is substantially devoid of resistance and impedance.

897,242. TELEPHONE SYSTEM. Harry G. Webster, Chicago, Ill., assignor to Milo G. Kellogg, Chicago, Ill. Means are provided for interrupting the normal connection during the connection of the ringing source.

897,243. TELEPHONE SYSTEM. Harry G. Webster, Chicago, Ill., assignor to Milo G. Kellogg, Chicago, Ill. Current sources of different potentials are used.

897,257. DYNAMOELECTRIC MACHINE. Max R. Hanna, Schenectady, N. Y., assignor to General Electric Company. The machine has two armature windings provided with commutators and adapted to be connected relatively in the supply and load circuits.